CONTENTS

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ORIGINAL COMMUNICATIONS.

MEMOIRS AND CASES.

ART. PAGE

I. Researches on the State of the Ganglionic Centres in Bright's Disease. By J. M. Da Costa, M.D., and Morris Longstreth, M.D., Physicians to the Pennsylvania Hospital, etc. 17

II. On Simultaneous Ligation of the Common Carotid and of the Subclavian in its Third Portion in the Treatment of supposed Aneurism of the Arteria Innominata, with a Case. By Lewis A. Stimson, M.D., Surgeon to the Presbyterian and to the Bellevue Hospital, New York. 52

III. Is the Action of the Medulla Oblongata in Normal Respiration Reflex? By Austin Flint, Jr., M.D., Professor of Physiology and Physiological Anatomy in the Bellevue Hospital Medical College, New York, etc. . 69

IV. The Diaphragm: A Protector of the Heart and Cardiac Vessels; its Influence on the Organs of Circulation. A paper read before the College of Physicians of Philadelphia, May 8. By W. S. Forbes, M.D., Fellow of the College, Senior Surgeon to the Episcopal Hospital, and Demonstrator of Anatomy in Jefferson Medical College, Philadelphia. . . 88

V. A Case of Fistula of Steno's Duct Following Gunshot Wound, Successfully Treated by Dissecting up the Posterior Extremity of the Duct and Conducting it into the Mouth, after the Method of Langenbeck, with some Remarks upon the Treatment of Salivary Fistulæ. By Erskine Mason, M.D., Surgeon to Bellevue and the Roosevelt Hospitals, Clinical Professor of Surgery in the Bellevue Hospital Medical College, New York. 97

VI. A Case of Ovariotomy in which Phlegmasia Dolens followed the Operation. By Walter F. Atlee, M.D., of Philadelphia. 102

VII. On the Physiological Pathology of the Blood. By Thomas Wharton Jones, F.R.S., F.R.C.S., Professor of Ophthalmic Medicine and Surgery in University College, London; Ophthalmic Surgeon to the Hospital, etc. 104

ART. PAGE

VIII. Gastro-Hysterectomy, or the Recent Modification of the Cæsarean Section by Dr. Porro. By Isaac E. Taylor, M.D., Emeritus Professor of Obstetrics, and of the Diseases of Women and Children, in the Bellevue Hospital Medical College, New York. 115

IX. The Results of the First Fifty Cases of "Cæsarean Ovaro-Hysterectomy," 1869–1880. By Robert P. Harris, A.M., M.D., Philadelphia, Ex-President of the Philadelphia Obstetrical Society, etc. 129

X. Contributions to the Structure and Clinical History of the Multiple Neuroma, from the Pathological Laboratory of the Alumni Association of the College of Physicians and Surgeons, New York City. By T. Mitchell Prudden, M.D., of New York. 134

XI. On the Physiological Action of Potassium Nitrite. By Edward T. Reichert, M.D., Demonstrator of Experimental Therapeutics in the University of Pennsylvania, with a Note on the Physiological Action on Man, by S. Weir Mitchell, M.D., Member of the National Academy of Science. 158

XII. Certain Traumatic Lesions of the Bones of the Orbit, with Caries and Perforation. By Charles Stedman Bull, A.M., M.D., Surgeon and Pathologist to the New York Eye Infirmary. 181

XIII. On Vaccination. Communicated by Walter F. Atlee, M.D., of Philadelphia. 188

XIV. Carbuncle of the Face. By F. A. Burrall, M.D., of New York. . 190

REVIEWS.

XV. Anæsthetics: their Position and Prospects.

Deutsche Chirurgie; herausgegeben von Prof. Dr. Billroth in Wien, und Prof. Dr. Luecke in Strassburg. Lieferung 20. Dr. O. Kappeler: Anæsthetica; mit 18 Holzschnitten, 105 Curven in Zinkographie und 3 Lithograph. Tafeln. Stuttgart, 1880.

Anæsthetics. By Dr. O. Kappeler; being Part XX. of "German Surgery," conducted by Profs. Billroth and Luecke.

Three Reports on the Action of Anæsthetics to the Scientific Grants Committee of the British Medical Association. British Medical Journal, Jan. 4 and 24, and June 21, 1879.

The Advantages and Accidents of Artificial Anæsthesia: A Manual of Anæsthetic Agents. By Laurence Turnbull, M.D., Ph.G., Aural Surgeon to Jefferson Medical College Hospital, etc. 2d ed., revised and enlarged. Philadelphia: Lindsay & Blakiston, 1879. . . 193

XVI. Surgery in the Pennsylvania Hospital. Being an epitome of the practice of the Hospital since 1756; including collations from the surgical notes, and an account of the more interesting cases from 1873 to 1878; with some statistical tables. By Thos. G. Morton, M.D., and William Hunt, M.D., Surgeons to the Hospital. With papers, by John B. Roberts, M.D., and Frank Woodbury, M.D., late Resident Physicians in the Hospital. Prepared by direction of the Managers of the Hospital. 8vo. pp. 349. Philadelphia: J. B. Lippincott & Co., 1880. . . . 219

ART. PAGE

XVII. Medico-Chirurgical Transactions. Published by the Royal Medical and Chirurgical Society of London. Volume the Sixty-second. 8vo. pp. lxix., 473. London: Longmans, Green, Reader, and Dyer, 1879. . 226

XVIII. Japanese Health Reports.

1. First and Second Annual Reports of the Central Sanitary Bureau of the Home Department of the Imperial Japanese Government, June 30, 1877. By Dr. Nagayo Sensai, Director of the Central Sanitary Bureau. Pp. 84 (with numerous tables).
2. Report of the Director of the Central Sanitary Bureau to H. E. the Minister of the Home Department on Cholera Diseases in Japan during the 10th year of Meiji (1877). By Dr. Nagayo Sensai, Director of the Central Sanitary Bureau. 235

XIX. De la Lésion des Organes Urinaires pendant l'Opération de l'Ovariotomie, par M. le Docteur G. Eustache, Professeur de Clinique chirurgicale à la Faculté libre de médicine de Lille, etc.

On Injury of the Urinary Organs during the Operation of Ovariotomy. By Dr. G. Eustache. 8vo. pp. 32. Paris: J. B. Baillière and Son, 1880. 240

XX. The Hypodermic Injection of Morphia. Its History, Advantages, and Dangers. Based on the Experience of 360 Physicians. By H. H. Kane, M.D., New York. 12mo. pp. 354. New York: Charles L. Bermingham & Co., 1880. 242

XXI. Skin Diseases, including their Definition, Symptoms, Diagnosis, Prognosis, Morbid Anatomy, and Treatment. A Manual for Students and Practitioners. By Malcolm Morris, joint Lecturer on Dermatology at St. Mary's Hospital Medical School, etc. With illustrations. 12mo. pp. 320. Philadelphia: Henry C. Lea, 1880. 243

XXII. Thirteenth Annual Report of the Health Department to the Honourable Common Council of the City of Cincinnati, for the year ending December 31, 1879. By Thos. C. Minor, M.D., Health Officer. 8vo. pp. 311. Cincinnati, 1880. 244

XXIII. Montreal General Hospital. Reports, Clinical and Pathological, by the Medical Staff. Edited by William Osler, M.D., M.R.C.P. Lond. Vol. i. 8vo. pp. xxii., 367. Montreal: Dawson Bros., 1880. . . 245

XXIV. The Essentials of Anatomy, designed as a Text-book for Students, and as a book of easy reference for the Practitioner. By William Darling, M.D., F.R.C.S., Professor of Anatomy in New York University, and A. L. Ranney, M.D., Adjunct Professor of Anatomy in New York University. 8vo. pp. xvi., 629. New York: G. P. Putnam's Sons, 1880. 251

XXV. The Influence of School Life upon the Eyesight, with Special Reference to the Public Schools of Dayton. By W. J. Conklin, M.D., Professor of Diseases of Children in Starling Medical College, Dayton, Ohio, 1880. Pamphlet, pp. 32. Dayton, 1880. 251

XXVI. Narrowing, Occlusion, and Dilatation of Lymph Channels; acquired forms. By Samuel C. Busey, M.D. Reprinted from New Orleans Medical and Surgical Journal, 1876–1878. 8vo. pp. 195. 252

ART. PAGE

XXVII. Post-Mortem Examinations, with especial Reference to Medico-Legal Practice. By Professor Rudolph Virchow, of the Berlin Charité Hospital. Translated from the Second German Edition, by Dr. T. P. Smith. 8vo. pp. 145. Philadelphia: Presley Blakiston, 1880. . . 253

XXVIII. Transactions of State Medical Societies.

1. Proceedings of the Louisiana State Medical Association at its Second Meeting, held in the City of New Orleans, April 9, 10, and 11, 1879. 8vo. pp. 206. New Orleans, 1879.
2. Transactions of the Thirty-fourth Annual Meeting of the Ohio State Medical Society, held at Dayton, June 3, 4, and 5, 1879. 8vo. pp. 218. Columbus, 1879.
3. Transactions of the Indiana State Medical Society, 1879. Twenty-ninth Annual Session. 8vo. pp. 252. Indianapolis, 1879.
4. Transactions of the Twenty-ninth Annual Meeting of the Illinois State Medical Society, held at Lincoln, May 20 and 21, 1879. 8vo. pp. 302. Chicago, 1879. 253

XXIX. A System of Medicine. Edited by J. Russell Reynolds, M.D., F.R.S., Professor of the Principles and Practice of Medicine in University College, London, etc. With numerous additions and illustrations. By Henry Hartshorne, A.M., M.D., lately Professor of Hygiene in the University of Pennsylvania, etc. In three volumes. Vol. III., Diseases of the Digestive, Blood-Glandular, Urinary, Reproductive, and Cutaneous Systems. 8vo. pp. 990. Philadelphia: Henry C. Lea's Son & Co., 1880. 258

XXX. The Principles and Practice of Gynæcology. By Thomas Addis Emmet, M.D., Surgeon to the Woman's Hospital of the State of New York, etc. Second edition, thoroughly revised. 8vo. pp. 875. Philadelphia: Henry C. Lea, 1880. 259

XXXI. The Microscope in Medicine. By Lionel S. Beale, M.B., F.R.S., Professor of the Principles and Practice of Medicine in King's College, London, etc. Fourth edition, much enlarged. 8vo. pp. 530. Philadelphia: Lindsay & Blakiston, 1878. 260

XXXII. A Text-Book of Physiology. By M. Foster, M.A., M.D., Prælector in Physiology and Fellow of Trinity College, Cambridge. From the third and revised English edition, with Notes and Additions, by Edward T. Reichert, M.D., Demonstrator of Experimental Therapeutics in the University of Pennsylvania. With two hundred and fifty-nine illustrations: pp. 1030. Philadelphia: Henry C. Lea's Son & Co., 1880. 261

XXXIII. Physiological Laboratory, Harvard Medical School, Boston. Collected Papers, 1873–1879. For private circulation. 8vo. pp. 205. . 262

QUARTERLY SUMMARY

OF THE

IMPROVEMENTS AND DISCOVERIES IN THE MEDICAL SCIENCES.

Anatomy and Physiology.

PAGE

The Origin of the Blood-Corpuscles. By Prof. Rindfleisch. . . . 263

Materia Medica and Therapeutics.

PAGE

On the Mydriatic Properties of Homatropin. By John Tweedy and Dr. Sydney Ringer. . . 266

Hypodermic Injection of Pilocarpine. By Dr. Ciaramelli. . 267

The Stigmata of Maize. By Prof. Castan. 267

On the Employment of Catgut for the Ligation of Arteries in their Continuity. By Dr. Eugene Boeckel. 268

Medicine.

Fatty Embolism. By H. Müller. 269

Starvation Fever. By Dr. J. M. Da Costa. 271

Salicin in Acute Rheumatism. By Dr. E. H. Greenhow . . 273

Salicylate of Soda in Acute Rheumatism. By Dr. E. H. Greenhow. 274

A Rare Case of Vaso-motor Neurosis of the Lower Extremity. By M. Straus. 277

Eruptions Caused by Internal Use of Chloral. By M. Brochin, M. Limousin, M. de Boyer, M. Gillet de Grandmont, and M. Grellety. 279

Surgery.

On New Methods of Removing Intra-laryngeal Growths. By Prof. Rossbach and Dr. Carl Langenbuch. 279

Nephrectomy by Abdominal Section. By Mr. A. Barker. . 280

Sulphide of Calcium in the Treatment of Suppurating Buboes. By Dr. Fessenden N. Otis. . . 284

Salicylate of Lime in Syphilitic Ulcers. By Dr. Rodriguez Viforcos. 286

Removal of Effused Blood from Joints by Puncture. By Prof. Volkmann. 286

Secondary Sutural Union of the Radial Nerve. By Prof. Von Langenbeck. 287

Ophthalmology and Otology.

Diabetic Hypermetropia. By Dr. Landolt. 288

A Case of Gonorrhœal Ophthalmia, with some novel suggestions as to Treatment. By Mr. George Critchett. 289

Antiseptic Dressings in Ocular Surgery. By Lucas-Championnière. 290

Midwifery and Gynæcology.

PAGE

On the Treatment of Pelvic Suppuration by Abdominal Section and Drainage. By Mr. Lawson Tait. 291

Case of Extra-Uterine Gestation Treated by Abdominal Section. By Mr. Lawson Tait. . . . 292

PAGE

Case of Extra-Uterine Fœtation about the Seventh Month of Pregnancy; Sudden Urgent Symptoms; Removal of Fœtus by Abdominal Section; Death. By Dr. Braxton Hicks. 293

Medical Jurisprudence and Toxicology.

Carbolic Acid Poisoning. By Kuster and Baumann. 295

On the Toxic Action of Salicylate of Soda. By Catti, Petersen, Gubler, Chirone and Petrucci. 296

Inhalations of Oxygen in Poisoning by Laudanum. By M. Crequy. 297

THE

AMERICAN JOURNAL

OF THE MEDICAL SCIENCES

FOR JULY 1880.

Article I.

Researches on the State of the Ganglionic Centres in Bright's Disease.

By J. M. Da Costa, M.D., and Morris Longstreth, M.D., Physicians to the Pennsylvania Hospital, etc.

These researches were begun in the spirit of pure investigation, since, so far as we were aware, no observations had been made of the condition of the ganglia or nerves supplying the kidneys in Bright's disease —a disease in which, as all are agreed, great alterations in the vessels and in the vascular supply, not only of the urinary secreting organs, but of the whole body, exist, or are brought about as the results of secondary changes. It seemed to us, therefore, that some morbid condition ought to be met with in the nervous arrangements that have for their chief office the regulation of the blood supply. Moreover, reflecting on the fact that the kidney affection is always both sided, and on the nervous phenomena which so often attend Bright's disease, we thought that exploration of the nervous system, especially of the ganglionic nervous system, might throw some light alike on the origin of the complaint and the accompanying signs of nervous disturbance. But while we were of the opinion that some altered states would be found to exist in the nervous centres, of the nature of such alterations we had no theory and no conclusions to substantiate; and now for the first time, more than a year subsequent to the investigation of the last case given in this series, and more than four years since our first observations, we attempt to formulate the results of the work. In the mean time, many cases of Bright's disease, in one or other of its many forms, have been partially investigated, but are not included in the present series, because we feared that they would vitiate the results, as some were cases of amyloid degeneration, others were complicated with coexist-

ing chronic disease of different character, and as in others, again, the specimens were not treated in precisely the same manner as was done with all the specimens in the present series.

In the first investigations, the nerve-trunks supplying the kidney were examined, but the results furnished nothing satisfactory. In all the present published cases, the method of treating the specimens—we refer particularly to the ganglia—was invariably the same; so that whatever criticism is made of the conclusions arrived at, none of the ante-mortem conditions, so far as preserved at the time of the autopsy, have been varied by irregularities of preparation. The difficulties of obtaining the ganglia were great, and the specimens required a long dissection, which was performed while they were kept submerged in the preservative fluid. The separation and isolation of the ganglia were rendered difficult by large amounts of fat surrounding them, inclosed in a firm connective tissue; the exceptions to this condition were found in Cases 7, 8, and 9, and partially in Case 6. The ganglia were obtained by removing, along with the kidneys and suprarenal capsules, all the structures in front of the vertebral column, including the aorta and cœliac axis, the attachments of the diaphragm, and the splanchnic nerves. From this mass the connective and adipose tissues were carefully separated, leaving the solar plexus and its nerve-branches. The portion of the ganglia examined microscopically was that from which the nervous filaments were given off for distribution to the kidney; other portions of the ganglia were also examined for comparison.

Let us now take a set of cases in which striking pathological changes were discovered.

CASE I.—This was a case of a single lady, aged 43, seen by one of us in connection with an eminent physician of Philadelphia. She had been at times under his care for a year with dyspeptic symptoms, but otherwise appeared in fair health; there was not a particle of dropsy. Spending the summer at the sea-shore, she had not been under observation immediately before the fatal illness, and sent for her physician in consequence of nausea and vomiting and some shortness of breath. A marked pericardial friction sound was detected, and an examination of the urine showed it to contain about one-third of the test-tube full of albumen and granular tube-casts. The malady became now as markedly vehement as previously it had been latent; twitching of the muscles, followed by general convulsions, set in. These were succeeded by uræmic coma, and death took place in about a week after the development of the pericarditis.

Post-mortem Examination, by Dr. Longstreth. November, 1877.—*Cavities.*—There was considerable serum in the peritoneal cavity, but no lymph. The *pleural* cavities contained more than the usual serum, which was bloodstained; but no lymph. The surface of the pleura was injected. There were some old adhesions on both sides. The *pericardium* showed an intense pericarditis. The walls were thickened, the sac distended with clouded serum and a large amount of lymph. The lymph lay in folds, was recent, and could be torn off from the surface of the heart or of the sac, leaving the membrane rough and displaying injected vessels.

Heart.—The ventricles were uncontracted, and contained a small

amount of blood and recent clots, less on the left side than on the right. The organ was of small size; its left ventricle hypertrophied. The cavities, orifices, and valves normal; the muscular structure firm and of dark colour, especially near the surface. The other organs of the body presented nothing of note, except the urinary apparatus.

The *kidneys* were much reduced in size, pretty regular in outline, but with a nodulated surface. The veins showed prominently on the surface of the capsule. The cortex was greatly wasted, in most parts barely forming a covering at the bases of the pyramids. The interpyramidal portions were reduced to a lesser degree, but had also suffered contraction. The straight tubes of the pyramids were twisted near the base. The colour of the pyramids was redder than the cortex, which presented an opaque striated appearance. The capsule was much thickened, and tightly adherent. After removal the surface of the kidney was found highly granular and nodular. The capsule did not tear the kidney on removal because of the great firmness of the organ, which was dense like cicatricial tissue. The kidney had a highly urinous odour, and was imbedded in a thick layer of fat, although the adipose tissue at other parts of the body was reduced in amount.

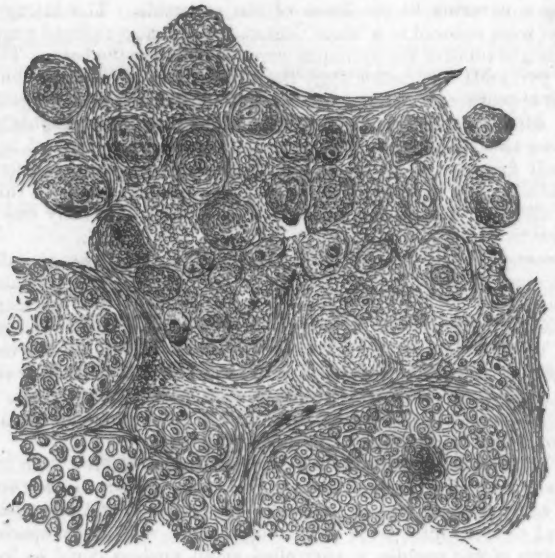
Microscopic Examination of the Renal Ganglia.—The capsule of the ganglia was composed of a broad band of thick-fibred closely-matted connective tissue; no cellular elements were present. Its vascular supply consisted of numerous large thick-walled vessels, especially the muscular tunic; scarcely any capillaries were visible in it. The adipose tissue was in large amount. The connective tissue was very marked along the nerve trunks, and penetrated the ganglion mass along with them. At the peripheral portion it encroached upon the nervous tissue, and sent into it bands of coarse fibres which will be described later.

The ganglion cells were in the highest degree altered. In unstained specimens they mostly appeared as yellow spots without distinct structure; rarely could any nucleus or nucleolus be detected, and very often they appeared as areas filled with large oil-globules. In stained specimens, in some parts of the ganglia, a shrivelled small nucleus could be frequently discerned, and more frequently the nucleolus; at other parts the condition of the cells was no better than that already referred to in the unstained specimen—the cell body filled with granules and fat, often considerable pigment, the nucleus and nucleolus nearly or quite invisible. Many of the cells were reduced in size, especially those showing markedly degenerated conditions; their outlines were irregular and sometimes puckered or folded. In many parts of the ganglia the whole substance over small areas was converted into a granular and fatty mass, the ganglion cells as well as the surrounding connective tissue having degenerated.

The connective substance of the ganglia everywhere presented a coarse, closely-matted, firm, fibrous appearance. It was generally devoid of cells, or, where these elements were present, they were highly granular and fatty. The cells were rounded in form; no elongated or spindle-shaped bodies were visible. This connective tissue encroached closely upon the ganglion cells, and often formed concentric coarse-fibred rings around them. The connective tissue entered the ganglionic mass along with the nerve trunks, and penetrated it from the envelope. It passed through the interior as broad bands of fibrillated tissue, which partitioned off the ganglion cells into very distinctly-formed compartments, often containing but a single cell, or twos and threes. The cells around which the con-

nective substance was the firmest generally showed greater degenerative changes than their fellows, but this appearance did not universally hold. The connective tissue development was often most marked in the central portions of the ganglia; it was by no means the condition universally found at the peripheral portions in connection with the thickening of the capsules.

Fig. 1.



At the left of the figure are seen the nerve-tubules in cross section, surrounded with increased connective tissue continuous with that covering the ganglia. The ganglionic cells show numerous oil-globules and granules. The basis substance between the cells is fibrous in character, and granular and fatty changes are present. × 350.

The vessels of the ganglia were not numerous; they were of large size, with thickened walls, and surrounded by large amounts of firm connective tissue, in which lymphatic vessels were visible. This case, indeed, was the only one in which the lymphatic vessels were discovered within the ganglionic mass, although vessels of this character were seen not unfrequently in the connective capsules in the other cases. The vessels were generally found empty, and some had collapsed from the contraction of the connective-tissue growth around them. In a few instances evidences of old hemorrhages in the interior of the ganglia, near some of its vascular trunks, were encountered, but none of them were of recent date.

The microscopic changes in the ganglia in this case were then of striking character, and involved all the component parts. The connective tissue covering the nervous mass was very much thickened; the con-

nective substance in the interior presented a firm fibrous appearance. The ganglion cells showed advanced degenerative changes, and were in many parts barely recognizable. The vascular supply exhibited marked alterations from the normal condition; thickening of the vessel walls, hypertrophy of the muscular coat, and increase of the surrounding connective tissue, with collapse and closure of their lumina.

The post-mortem examination proved that the kidney disease was of long standing, and that the contraction of the organ had advanced very far. A careful microscopic study showed the changes to be similar to those usually found in kidneys presenting the gross appearances already described.

CASE II.—Mary A. D., æt. 60, widow, was admitted to the Pennsylvania Hospital, December 24, 1878. She was picked up in the street in an unconscious condition and brought to the hospital at 9.15 P.M. No history could be obtained as to her previous health. She could be only very slightly aroused, but did not speak. The pulse was 90 per minute, strong and full; respiration 28, and rather laboured. The right pupil was contracted to about one-third below the average size, and the left one as markedly dilated; both were insensible to light. Over the whole chest loud mucous râles were heard, so loud that the character of the heart-sounds could not be determined. There was no obvious paralysis. Her breathing gradually became stertorous, and slight convulsive movements of the muscles were noticed every few minutes, lasting a few seconds. There was no œdema of any part of the body. Her urine, drawn with catheter, was found to contain a large amount of albumen (about one-third), and the microscope showed the presence of granular casts. The patient died eight hours after admission.

The *post-mortem examination* was made by the Coroner's physician, and no accurate notes were obtained. A large apoplectic clot was found in the left half of the brain. The kidneys were very considerably contracted, and many small cysts were present on their surface. The capsule was thickened and adherent, and the cortex was very greatly reduced in thickness. The organs were imbedded in a large amount of fat, and had a strongly urinous odour.

The surface of the *kidney*, as seen in the microscopic section, was highly granular; the capsule was thickened, and was composed of coarse-fibred connective tissue, closely matted together. Numerous large and small sized vessels were distributed through it, and in places they connected with the vascular supply of the cortex. The lymph spaces in the capsule were not numerous or large. The union to the cortical tissue was very intimate, and in many places the capsule dipped down and was continuous with broad connective-tissue bands in the periphery of the organ. The point of junction between the two was marked by the aggregation of round cells, which stained very deeply with carmine. Several cysts were seen on the surface, mostly occupying the cortical tissue, but also projecting and causing a prominence of the capsule.

The thickness of the cortex was greatly reduced; under a magnifying power of 50 diam. its width occupied a little more than the breadth of one field of the microscope. The arrangement of the component parts in the cortex was found much altered; the Malpighian bodies were very irregularly placed, and the tubes of the cortical pyramids pursued a twisting

direction. The Malpighian bodies were of pretty regular outline, but were surrounded by a broad capsule of connective tissue, which presented a swollen appearance, and contained many new cellular elements, mostly spindle shaped. The Malpighian bodies frequently appeared as homogenous, concentrically arranged connective-tissue masses, without cellular elements and without traces of the capillary tufts. In other parts the capillary tufts were indistinct from the presence of cellular collections themselves granular and indistinct, but in some they were injected and the blood corpuscles were readily distinguishable. The convoluted tubes were irregular in outline, their basement membranes moderately swollen; their epithelial cells were very granular and a little fatty; their nuclei generally obscured and staining poorly with carmine. In other tubes the nuclei were sharply defined and well coloured, but the bodies of the cells were still very granular, but less so than in the other instances. Many tubules were filled with casts or granular matter.

The connective tissue between the tubules was everywhere swollen and increased; in many parts of the cortex it was packed full of cellular elements, both round and spindle-shaped; so great were these collections of cells that in places the outlines of the tubules were concealed; in other parts the tubular structure was lost in firm, coarse-fibred connective tissue. The various parts of the cortex exhibited great differences in the degree of alteration which had taken place in it.

The branches of the renal artery at the bases of the pyramids showed as widely stretched-open, thickened walled vessels, surrounded by an increased amount of connective tissue. The muscular coat was greatly hypertrophied. The connective tissue around the vessel was prolonged into the cortex, and in places was filled with cells which obscured the tubules, but in other places there was a coarse-fibred overgrowth which had destroyed the cortical structure and into which small hemorrhages had taken place.

The vessels of the cortex showed greatly thickened walls, but their course was so altered from the straight direction that they could not be traced. The straight tubes of the medullary cones showed no changes, but the vasæ rectæ were dilated and injected, and the connective tissue around them was increased.

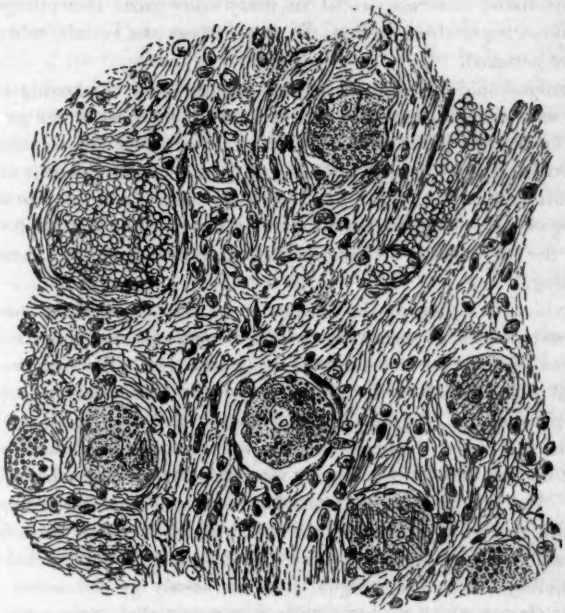
The *ganglionic masses* were enveloped by a thick layer of connective tissue, richly supplied with bloodvessels and encroaching on the nervous tissue and also accompanying the nerve trunks at their exit from the ganglia. There was a considerable mass of adipose tissue around this tissue. The nerve trunks showed an increased amount of connective tissue in their interior as well as surrounding them, but neither here nor in the connective tissue enveloping the ganglia was there any abnormal abundance of cellular elements.

The ganglionic cells were much altered. They appeared shrunken, and their outline was indistinct. The nuclei and nucleoli were difficult to make out. The cell bodies were more or less filled with fatty granules, in some cases occupying nearly its whole space, in others collected in heaps, or else isolated and scattered through the interior. They were also generally markedly pigmented.

The tissue of the ganglia was composed of finely striated connective tissue, in most places clear and nearly transparent, or else having a granular aspect; in other parts, generally towards the periphery, there were present in it pale, usually indistinct, and poorly stained round cells or

nuclei. In the peripheral portions the ganglionic cells, when not overlaid and obscured by the new cellular elements, generally showed their structure more distinctly than in the parts more central.

Fig. 2.



The ganglionic cells show fatty degeneration, and their outlines are indistinct; their nuclei and nucleoli obscured. The basis substance is fibrous and contains some cellular elements. The vessels are large and filled with blood-corpuscles. × 350.

Many large capillary vessels were seen, especially near the superficial portions of the ganglia, entering it either from the connective tissue or along the nervous trunks; in the interior the vessels were of smaller lumen and surrounded by especially thick connective tissue.

The general aspect of the sections in this case gave the impression of degeneration of the ganglionic cells of marked degree, and of a connective-tissue overgrowth within the ganglia which had progressed beyond the stage of granulation tissue to completely formed fibres in which the cellular elements were no longer visible.

We shall not dwell on the interesting clinical questions here connected with the profound coma, the state of the pupils, and the double lesion which determined the symptoms, but, in accordance with our purpose, pass on to an examination of the renal affection.

The appearances of the kidneys and their microscopic examination show conclusively that the renal disease was of long duration, and was of

that form which is so frequently unattended with the obvious symptoms of Bright's disease. The contraction of the organ is found not to be equally complete at all parts. In many the process of interstitial inflammation is still in progress, evidenced by the presence of the numerous connective-tissue elements, whilst in many other parts this process has advanced to cicatrization, and in the latter areas the vessels, tubes, and cells have perished.

The microscopic appearances of the ganglia show thickening of the capsular envelope and markedly degenerated appearances of the ganglion cells. The changes in the connective substance of the ganglia demonstrate a connective-tissue hyperplasia by the increased cellular elements and increased firmness of the fibres; but both these constituents are also undergoing degenerative changes, for both are granular. The increased vascularity of the specimens is a striking feature; their vascularity is, however, diminishing.

It is evident in reviewing the description we have given of the condition of the renal ganglia, as seen with the microscope, that very grave changes have taken place in the structural elements, and that these changes were somewhat proportional to the alterations of the kidney and also to the clinical phenomena. In fact, while arranging and classifying our cases for use in this paper, the question arose whether the classification should be made on the basis of the kidney alterations or on those found in the ganglia. But this question in great degree solved itself, for it was soon found that, viewed in either way, the examples fell into the same classes. We do not wish to imply that the cases, in the changes they exhibit either of the kidneys or in the ganglia, form an evenly graded series. The groups or classes which we have made imply only that some cases show greater changes than others, and not that the changes of one class are of different character from those found in the other; the classification, in other words, is made on the basis of quantity rather than of quality.

In group I. are then the cases with the most striking alterations. The first is a well-marked one of chronic Bright's disease with contracted kidney, characterized by a long period of latency of the symptoms, followed by an outburst of inflammation of the serous membranes, which acted as the proximate cause of death. In the second case, the ante-mortem conclusion that the kidneys were much diseased was confirmed by the autopsy, and the death here resulted, as so frequently occurs in cases of contracting kidney, from cerebral hemorrhage. The kidneys in each of these instances belong to the variety characterized by the results of interstitial inflammation, and the changes in the muscular coats of the arteries were such as are usually found in this variety.

Without further particularizing the kidney changes, let us see what are the alterations in the ganglia, and what conclusions are to be drawn from the microscopic appearances presented. In the first place we wish to

emphasize the condition of the tissues surrounding not only the kidney but the ganglia, viz., the accumulation of fat around the former, and the firmness and tight adherence of the connective tissue, inclosing in its meshes adipose cells, around the latter. The increase of fat around the kidney in chronic Bright's disease is a condition with which we have long been familiar. The accumulation of fat is invariably very great, irrespective of the condition of the other portions of the body in this respect. In a cadaver in which fat is to a great degree absent from the places in which this tissue usually accumulates, it is nevertheless found in large amount around the contracted kidney. One or even two inches of fat is no unusual amount to be found around these organs even in emaciated subjects dying of chronic contracted kidney. The fat, too, is firmly adherent to the organ, and penetrates the chinks around its pelvis, and on the principal section of the kidney is seen to be intercalated with the calyces. The deposit of fat is a very striking condition, and to which hitherto no allusion has been made.

The ganglion cells present changes such as are usually described as fatty degeneration and atrophy. There is breaking down of their substance into granules and fatty globules, which more or less obscure the nucleus, and even when the nuclei are visible they show more or less the same changes.

The connective basis-substance of the ganglia has apparently passed through the active stage of hyperplasia, and is undergoing the contractile process which we are so familiar with in the kidney, and which we have also found to have taken place in the tissues outside the ganglionic masses. This substance has passed the active stage of formation, and its elements also are undergoing degenerative changes.

We shall next look at a series of cases forming a *second group* in which the disease was somewhat different, and the renal changes less marked, though still very obvious.

CASE III.—Catherine R., æt. 35, was admitted to the Pennsylvania Hospital, March 24, 1879, suffering from a lacerated wound of the left forearm, caused by falling through a window nine days previously, while drunk. The wound was dressed, and she was attended to daily at the out-patient department until the 24th inst., when she was sent into the wards suffering from severe diarrhœa and incontinence of urine. The patient had been a hard drinker for a long time, and had led an exposed life. The wound was very slow in healing. The urine was albuminous, but, owing to the difficulty in collecting more than a very small amount, no casts were discovered by the microscopic examination. She died suddenly six days after admission, March 30th.

Post-mortem examination, by Dr. Longstreth.—*Cavities.*—The *peritoneum* showed nothing of note. There were many old *pleural* adhesions. The *pericardium* was normal.

Heart.—The ventricles were relaxed. The aortic valves showed old endocardial disease, but were not incompetent. The left ventricle was

slightly hypertrophied, its tissue was pale and less resistant than normal. The cavities were of normal size. Weight, 10 ozs. The *aorta* was dilated, and presented atheromatous changes at its transverse portion. *Lungs.* Both apices showed old cicatricial depressions, and small quiescent cheesy nodules. The *spleen* exhibited a patch of chronic capsulitis, and its fibrous tissue was increased. Weight, 8 ozs. The *liver* was irregular in outline, firm, and reduced about one-half in size. The fibrous tissue was much increased, and its capsules thickened and adherent, leaving on removal a granular surface.

The *kidneys* were reduced in size, presenting a slightly swollen appearance; firm, and irregular in outline. On section, the cortex was found much diminished in thickness, the capsule was tightly adherent and thickened, and on removal left the surface of the organ markedly granular. The urinous odour was very decided. There was no disease of the ureters or bladder. In a microscopic section of the organ, cut vertically, the capsule was seen to be much thickened; it was composed of coarse connective tissue fibres, rather widely separated, and presenting a swollen aspect. The capsular connective tissue was thoroughly permeated by blood and lymph spaces, which gave it a net-like appearance, and its tissue was in places crowded with cellular elements. On the surface of the cortex, in one of the sections, could be seen a small cyst, which had raised the capsule. Both in the capsule and in the cortex at its outer portions the accumulation of cellular elements was especially marked.

The walls of the larger branches of the renal artery, at the junction of the cortex and medullary portions, showed an increase in the thickness of their coats of marked degree; the change was especially noted in the muscular coat; the connective tissue around the vessels was greatly thickened, and in many places was crowded with new cellular elements. The vessels of the cortex (arteriolæ ascendentes) showed dilatation, thickening of their walls, and were tortuous in their course. The thickening consisted in hypertrophy of the muscular cells, the nuclei of the muscular fibres being very distinct. This condition was present in all the arterial vessels, both the larger and the smaller ones.

The condition and appearance of the Malpighian bodies differed greatly in the various parts of the section. Some of the bodies showed but slight increase of their connective-tissue capsules, or whilst in some this connective tissue was swollen and hyaline-looking, its individual fibres were not dense and broadened. In the majority of the bodies the capsules were thickened to three or four times their normal width; in all of them the cellular elements were very abundant, in some crowding the spaces between the capillary loops and even obscuring the vessels. The capillary tufts varied greatly in their condition in different parts of the kidney; in some bodies the circulation was evidently very free, the capillaries having their ordinary calibre; in others, the accumulation of cellular elements was so abundant, and the increase of connective tissue so marked, that the lumina of the vessels were encroached upon. This, at least, was the post-mortem picture presented, whatever may have been the actual state of the circulation during life.

The connective tissue between the convoluted tubules was also increased, varying, however, in different parts of the kidney, from a simple swelling of this tissue, with a greater or less abundance of infiltrated cells, to a heavy-fibred tissue, which was generally devoid of the cellular elements, except in parts near the larger vessels, or near markedly com-

pressed Malpighian bodies. The increase of connective tissue had, of course, led to compression of the tubes; this change was more noticeable at the peripheral portions of the cortex.

The condition of the epithelial cells of the convoluted tubes was in places nearly normal, and in these parts little change was found also in the intertubular spaces; in other parts, the cells were very highly granular, their nuclei obscured, and, in some, fatty changes were evident. A large number of the tubes were filled with tube casts, containing abundance of granular matter and detached and degenerating epithelium.

The straight tubes of the cortical pyramids and the tubes of the medullary cones, as well as their surroundings, showed little change. In the latter set of tubes, a number of tube-casts were visible *in transitu*.

The vascular connection between the cortex and the capsule of the organ was greatly increased, and in many sections large vessels were seen passing both from one to the other, filled with recent coagula, in which the red corpuscles could be discovered. Around these new vascular trunks the cellular infiltration of the tissue was always more abundant, and the intertubular connective-tissue changes most advanced.

Microscopic Examination of the Renal Ganglia.—The periphery of the nervous mass was seen to be surrounded by a broad layer of connective tissue, the individual fibres of which were stout and generally closely matted; in many parts the connective tissue was looser and the meshes filled with adipose cells. The nerve trunks entering the ganglia were also surrounded by a firm connective tissue, more abundant than in the normal condition, which was in parts filled with small cells or nuclei, which very readily took the carmine staining. The fibres of the nerve trunks and also the nerve bands or tracts within the ganglia were normal.

The nerve cells (ganglionic cells) at all parts, though varying in degree in different situations, presented strikingly abnormal conditions. The nucleoli were not visible in the great majority of the cells; in fact, in only a few instances could the nucleoli be seen as clear shining bodies within the nuclei; in others the existence of them could be made out only by the lighter shade of colour at some part of the nuclear body. In no instance did they present a normal appearance. The nuclei stained with carmine but poorly, their outline was often irregular, in some instances angular, and their structure could not be distinctly studied owing to changes in the cell body, but no alteration was found in them.

The bodies of the ganglion cells, in the great majority of cases, were irregularly shaped and angular in outline; some, however, were round and plump looking, and these cells showed their nuclei and nucleoli quite distinctly and in their general appearance were more normal looking. In the majority the cell body was highly granular, and exhibited numerous minute oil globules. The oil globules were irregularly aggregated, in some, occupying a small area at one end of the cell, in others, placed more centrally, close up to the nucleus, and in others, nearly the whole cell body was occupied by them. The degree of fatty change seemed to bear some relation to the shape of the cell, the greater the degenerative changes the more irregular the shape. The processes of the ganglion cells could in many cases be traced a short distance from the cell body.

The substance of the ganglia, the tissue around the ganglionic cells, showed in this case very marked alterations and deviations from the normal. It was made up of an almost transparent granular basis, in which at places a fine striation could be detected. In the basis substance were cells of vary-

ing shape and size, some apparently simple nuclei, others having a very small body containing a relatively large nucleus—the nuclei in both cases were about the same size; others were of irregular shapes, some elongated at one pole, others bipolar, and others presented an elongated spindle-shaped figure, having a centrally placed nucleus and long waving processes. These cells stained deeply with carmine, the nucleus of course taking a deeper coloration, but the whole body of the cell was also more or less coloured, except in some of the more elongated spindle cells, whose processes remained uncoloured. The arrangement of these cells presented no definite regularity. In some places they were heaped up around the ganglion cells, and were frequently seen overlying the cell bodies; in other parts they were less abundant, and often formed a ring or cleared space around the nerve-cells. The spindle-cell processes did not take any general direction, and were often seen lying across each other. The ganglion cells around which were cleared spaces, were usually more normal in appearance than those around which the cells were closely heaped, but exceptions to this rule were noticed.

The vascular supply of the ganglionic tissue was greatly increased; numerous capillaries were found, and numbers of large dilated thin-walled vessels in which the red corpuscles were crowded. The cellular elements were abundant in those parts where the increased vascular supply was found, and spindle cells were also more abundant here, and were often found arranged either parallel or concentrically to the lumen of the vessel.

The exciting cause of death in this case was the injury received about a fortnight previously. The history of the patient further shows that her mode of life was such as to produce kidney disease. For the completeness of the case it is to be regretted that the microscopic examination of the urine was not more successfully carried out, but with the aid of the post-mortem record nothing is needed to classify this case along with the others, as one showing advanced renal disease.

The microscopic examination of the kidney showed that the organ was to a marked degree contracted, and that the change was of considerable duration. The interstitial process, however, had not subsided or was perhaps rekindled to greater activity as the result of the injury from which the patient had suffered. The epithelium of the tubules was in the condition usually found in kidneys of this character; in parts where the contraction was marked the cells were greatly degenerated or had wholly disappeared, whilst in others where the connective tissue changes were less advanced the epithelia were often found well preserved.

The renal ganglia, in this case, presented marked evidences of degenerative changes of its ganglionic cells. The connective substance of the nervous masses showed decided formative activity of its cellular elements; the vascularity was greatly increased.

CASE IV.—Adolph L., æt. 50; married, gasfitter; was admitted to the hospital September 19, 1878, in an unconscious condition. But shortly consciousness partially returned, and when asked his name he said L., yet this was the only response in words that could be gotten from him. No history could be obtained of his previous condition. Both pupils were

tightly contracted. Respiration 24; pulse 90, full. Twitchings of the muscles of the left side of face were noticed; the right side of the face was paralyzed. His mouth was drawn somewhat to the left, and on protruding the tongue its tip deviated to the right. The right arm and leg were paralyzed. The urine was cloudy, acid, sp. gr. 1009. It contained about one-sixth its bulk of albumen.

20*th*. General condition about the same; intelligence improved; he muttered when spoken to, but no words could be distinguished. He was rather restless in bed, and had passed his urine and feces unconsciously. Swallowed fluids with some difficulty. His chest was full of coarse mucous râles. No cardiac murmurs were heard. The superficial arteries were noticed to be very tortuous.

21*st*. His condition about the same. A microscopic examination of his urine showed that it contained great numbers of highly granular and fatty casts, as well as hyaline and oil casts, free fat globules, and fatty and granular renal epithelium. Respirations 48; pulse 160.

22*d*. Respirations 42; pulse 168. Total paralysis of sensation and motion over the right half of body. Death at 11 P. M.

Post-mortem examination, by Dr. Longstreth.—*Head.*—Calvaria normal. The dura mater was found tightly adherent to the bone and in places to the convexity of the brain. At the base, the vessels were markedly atheromatous. The left lateral ventricle was filled with black clots of blood, which came from an extensive laceration of the optic thalamus. The *cavities* of the body presented nothing especial.

Heart.—Weight 12 oz. avoird. Its left side was firmly contracted; its right side was distended with clots. The aortic valve was competent, but both the aortic and mitral valves were atheromatous; their surfaces were smooth. The left ventricular cavity appeared of smaller size than normal, and its wall was thickened, especially towards the base. The *lungs* showed deep posterior congestion.

Kidneys were much reduced in size; the left one weighed 2½ ounces; the right 2 ounces. They were of a pale yellowish colour, rather flabby in consistence; their capsules thickened, not tightly adherent, and after removal left the surface of the organ finely granular. The cortex was much reduced in thickness, although its thickness in proportion to the length of the medullary cones, was less altered than is usual in kidneys so much reduced in size. They had a strongly urinous odour.

Microscopic Examination of the Kidney.—The surface was uneven and irregular in outline, but not markedly granular, although at places granulations were visible. The capsule was moderately thickened, loose in structure and not strongly adherent to the surface of the organ. Several large vessels were seen in it, and the remains of numerous small ones; and the lymph spaces were large and filled with a granular debris. Beneath the capsule were a number of cysts not larger than Malpighian bodies. The connective tissue of the capsule was encroaching on the cortex, and several of the Malpighian bodies were involved in its deeper layers. The walls of the bloodvessels were only moderately thickened, the increase being due to swelling of their tissues. The connective tissue surrounding them was of loose character, and the middle layer showed its muscular fibres very indistinctly, and this portion exhibited marked granular degeneration.

The capsules of the Malpighian bodies appeared as broad bands of swollen connective tissue, nearly devoid of cellular elements. These cap-

sules did not show as well defined, firm connective tissue directly encircling the capillary tufts as in many of the other specimens, but as a loose tissue extending diffusely into the surrounding area, and involving and destroying the neighbouring tubules. Very many of the Malpighian bodies appeared as homogeneous structureless masses, very granular in character and pigmented; in others, the capillaries showed distinctly, but not injected, and were surrounded by a slightly increased connective tissue.

The convoluted tubes were irregularly swollen in some places and contracted in others; many tubes were stripped of their cellular lining, empty and collapsed. Their basement membranes were swollen and thickened, and in many places fused with the surrounding overgrowth of connective tissue. The epithelial cells were highly granular and fatty; their nuclei were, as a rule, not visible, and the whole group of cells lining the tubules were swollen. The lumina of the tubules were choked with casts of great variety of structure; though mostly granular and fatty. The straight tubes of the medullary cones were much altered; their epithelial linings were indistinct, and very many of them were filled with casts.

The connective tissue of the cortical portions was greatly increased; the spaces between the tubules were widened, the tissue fibrillated and granular, and mostly devoid of cellular elements. In many places the encroachment of the intertubular connective tissue and the collapse of the tubules had converted the cortical substance into a mass of striated fibrillar tissue, in which holes of small size filled with granular detritus, were seen.

A general survey of the cortex showed that in about one half of it the tubules, with their degenerated epithelium in position, were intact, and that in the other half the connective tissue overgrowth, itself in a highly granular condition, had encroached upon and destroyed the tubules and Malpighian bodies, so that only their remains could be detected.

Microscopic Examination of the Renal Ganglia.—The ganglia were surrounded by thick, firm, connective masses, very abundantly vascular, and containing a moderate amount of adipose tissue. The connective tissue was especially abundant around the nerve trunks at their points of exit, and was unusually noticeable in the interior of the nerves.

The ganglion cells presented a confused, indistinct, and smeared appearance; they were very distinctly isolated from their surroundings, but their outline was irregular, and the cell bodies looked as though shrivelled. This condition was more marked in the more central portions of the ganglion, while towards the periphery many cells were more plump and rounded. The substance of the cell bodies appeared degenerated, although the granular and fatty changes in them were not as distinctly visible as in many of the other cases; in the stained specimens the tissue appeared like a blot of colour without definite structure. The nuclei were mostly very indistinct, and appeared blended with the cell body. The nucleolus, however, was very frequently discernible as a dark dot.

The tissue of the ganglia was strikingly altered. It was mostly composed of a coarse, firm, connective-tissue substance, in which were seen a moderate number of small round cells or nuclei and spindle cells. These cells, especially the round ones, were highly granular and not perfectly rounded, and the spindle-shaped ones were being converted into fibres. They stained very imperfectly. In the central portions of the ganglia this connective tissue was firmer and coarser, and was arranged so as to form cleared spaces concentric to the ganglion cells.

The vascular supply within the ganglia was scanty, and was carried on

by relatively large capillaries, surrounded by considerable firm connective tissue; numerous collapsed capillaries were also seen. The large vessels were injected, and several small hemorrhages were found near them, both at the periphery and in the interior of the ganglionic masses. Study of the condition of the capillary walls was impossible on account of the presence of the blood corpuscles within the vessel.

The history shows the condition of degeneration present in the greater portion of the arteries, and that the patient was suffering from chronic Bright's disease. His death resulted from cerebral hemorrhage, which is so frequently a consequence of contracted kidney. The autopsy records that the kidney had suffered at a period considerably prior to death, from interstitial inflammation. The much reduced size of the organs is, however, not entirely due to the contraction of the intertubular inflammatory tissue. This change had caused its usual effects in the tubular epithelium, and this portion of the organs had become markedly degenerated. The disease of the arterial system had contributed largely to the atrophy and degeneration found in all parts of the organ. The alterations in the kidney are, therefore, to be looked upon as due largely to atrophy and not solely to contraction. The interstitial inflammation was the first step in the morbid changes; the tubular epithelium suffered from the effects of the contraction of the inflammatory products, and both of these structures were further altered by atrophic degeneration caused by the atheroma of the arteries. That this interpretation of the condition of the kidney is correct, is evidenced by the flabby consistence of the organ as compared with its reduced size and weight.

The appearances of the ganglia prove that their connective tissue capsules are thickened, and that the changes in the periphery are accompanied by similar connective tissue hyperplasia in the interior, the fibres of which are coarse and firm, and there are present in this tissue new cellular elements, some of which are passing into fibrillar tissue, some or most of them are degenerating. The ganglionic cells are degenerated also, more particularly in their nucleus and nucleolus. The condition of the capillaries is also striking; the increase of connective tissue around their walls, and the evident degeneration of their tissue, evidenced by the occurrence of small hemorrhages, are especially to be noted.

Case V.—Wm. S. E., æt. 54, manufacturer, admitted to the Pennsylvania Hospital, March 6, 1878, in a nearly comatose condition, was unable to speak, but pointed to his pocket where letters were found directed to him. There was almost complete loss of power of his right arm and leg, the face was flushed, the conjunctival vessels were injected, and his pupils contracted. The first sound of the heart was heavy, the pulse regular, slow, and full. The radial arteries were markedly atheromatous. Later, he was able to speak a little, and made the statement that he felt well on leaving home in the morning, and while walking along the street became faint and fell unconscious. No further history could be obtained from the patient, partly from his stupid condition, but more especially on

account of his difficulty in speaking. The next day he was more intelligent, but his speech was very thick.

8th. Rather duller. Bowels opened by purgative. The urine was passed involuntarily; the small amount collected was opaque, yellow-coloured, alkaline, sp. gr. 1017, and contained albumen. With caustic potash, the urine became thick, viscid, and stringy. No casts were found on superficial examination with the microscope; the determination of their presence was, however, very difficult, owing to the thick sediment. He died on the eighth day without striking changes of the symptoms.

Post-mortem examination, by Dr. Longstreth.—*Head.*—A large clot of blood, which originated from the left optic thalamus, filled the left lateral ventricle. The walls of the cerebral arteries were atheromatous.

Cavities.—The *peritoneal* and *pleural* cavities presented nothing especial to note. The *pericardium* contained a small amount of blood-stained serum, its vessels were injected, and there was a very fine layer of lymph on its surface.

Heart.—Right side relaxed, left moderately contracted; its cavities nearly empty. Its orifices were normal in size, and its valves competent. Coronary arteries rigid and atheromatous. The commencement of the aorta was slightly dilated, and showed marked atheromatous changes, making its surface uneven. The mitral leaflets were atheromatous, but presented a smooth surface. The aortic valves were not changed. The cavity of the left ventricle was of normal size, its wall measured, at mid-ventricle, $1\frac{1}{2}$ inches in thickness, towards the apex much less. The muscular tissue was rather flabby but resistant.

The *lungs* were emphysematous anteriorly, whilst posteriorly they showed deep congestions. The *spleen* was small, firm, had a nodular feeling. On section, the nodules appeared like areas of infarction. The *liver*, *stomach*, and *intestines* presented nothing especial to note.

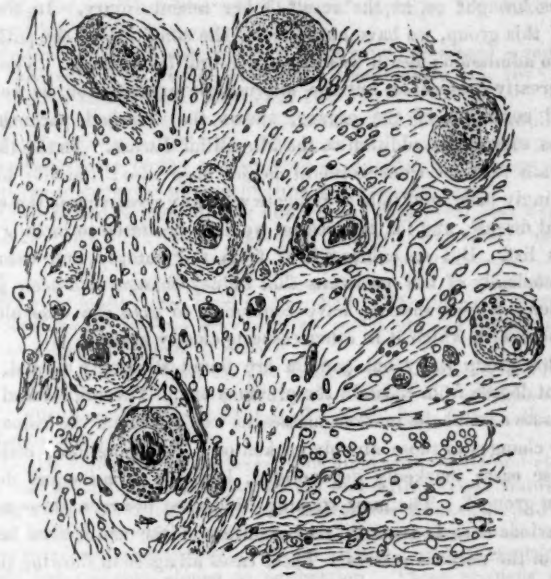
Kidneys.—The left was small, not very firm, and slightly irregular in its outline. The capsule was opaque, thickened, and adherent, and on removal tore the tissue of the organ and left a highly granular surface, on which the stellate veins were distinct. The cortex was found much reduced in thickness, and its tissue was opaque and mottled. The organ had a distinctly urinous odor. Weight three ounces. The right kidney presented the same general characters. The bladder mucous membrane was swollen, and probably in a state of catarrhal inflammation of slight degree. Urethra not examined.

Microscopic Examination of the Renal Ganglia.—The connective tissue capsule of the ganglia was found moderately thickened and firm in parts, and contained within its meshes numerous cellular elements. The adipose tissue in it was abundant, and the vessels were not numerous, but some had very abnormal walls.

The ganglionic cells were irregular in their outline, some appearing shrivelled; their structure was markedly indistinct, and they contained abundant granular and fatty matters, and some also considerable pigment granules. Their nucleus was generally invisible, or some portion of its outline was invisible, from the accumulation of granules or fat. The nucleolus presented a dark outline or a black spot; it was rarely bright or shining. The connective substance of the ganglia had a coarse, highly granular or even fatty, striated, or fibrillated appearance. There were numerous cells in it, in some portions nearly all rounded, but of highly granular aspect, in other portions numerous elongated cells. These cellu-

lar elements stained imperfectly, and were faint or indistinct. The vascular element in the nervous masses was poorly represented in quantity, but the vessels seen in it presented marked thickening of their walls; there was hypertrophy of the muscular coats to a considerable degree, and of the connective tissue around them.

Fig. 3.



The ganglia cells are changed in outline, show many oil-globules, the nuclei form black dots or outlines. The connective tissue is fibrillated and contains very numerous new cellular bodies. × 350.

The atheromatous condition of the superficial vessels and the cerebral hemorrhage both indicated degenerative changes in the internal arteries of the body.

The microscopic sections of the kidney were spoiled through some defects in the mounting. Sufficient, however, is known of the minute appearances to enable us, in connection with the evident alterations seen by the naked eye, to classify this case with the others. The kidney showed atrophic changes as well as marked evidences of contraction and of degeneration of the epithelium.

The degeneration and atrophic changes in the ganglia were very evident both in the ganglion cells and the connective substance. It is also evident that at some period active changes were present in the latter constituent. The muscular coat of the arteries was altered in this case in the way which has been described in so many of the previous ones.

In group II., the group just described, the life history and the condition of urine and kidneys, show that either the renal disease was of a somewhat different type or that it was less advanced. In the first case the patient had led a life strongly predisposing to kidney disease; the kidneys were of the contracting variety, and the slightly swollen condition noted at the autopsy probably resulted from intercurrent, subacute changes brought on as the result of her recent injury. In the second case of this group, we have no report of the condition of the patient previous to admission; death was due to cerebral hemorrhage. The kidneys were greatly contracted, but the microscopic examination, as well as the general condition of the organs, shows that marked parenchymatous changes existed in addition to the interstitial disease. In the third case the death resulted from cerebral hemorrhage also; the life history is exceedingly brief, and fails to indicate with any positiveness the existence of renal disease, and for this reason we have hesitated to include the case in this list. But so evident is it from the autopsy and examination microscopically of the specimens that kidney changes had been going on for a long period, that we have concluded to give the case along with the others with which it in other respects closely agrees.

In this group the renal ganglia are found strikingly altered, but to a different degree from those in the previous one. The adipose and connective tissues around the nervous masses, as well as around the kidneys, show similar changes to those already spoken of. The ganglionic cells are in all these cases markedly degenerated, but not to an equal degree to those in group I. The most striking difference between these cases and the previous ones is seen in the condition of the connective basis substance of the nervous masses. These cases all agree in showing this tissue filled to a greater or less extent with small cellular elements, having the usual characters of connective-tissue elements. In the previous group, as already pointed out, the active hyperplastic changes in this tissue were considered to be subsiding; the cellular elements had passed on to the formation of fibres, although a few were still to be seen. In this group of cases the cellular elements are in great abundance, some presenting themselves as round nuclear bodies, others as spindle-shaped cells, but the contractile changes of this tissue are much less marked than in the previous group. The display of vessels in and around the ganglia is very prominent, and is in co-ordination with the progress of the histological alterations of the morbid process, and in correspondence with the relative advance of the kidney changes.

Yet another group presents itself for examination, and in this *third group* we have more of the clinical features as well as the pathological changes in the kidney of catarrhal inflammation, mostly of the acute type, and we shall find the disease in the ganglia much less marked.

CASE VI.—Charles O., æt. 28, single, bartender, was admitted to the hospital on Wednesday, February 6, 1878. He had always been in good health, but had been a hard drinker. On Sunday previous to his admission he awoke with a severe headache, having gone to bed the night before well. This condition continued, and, on the day before admission, he was seized with a chill, followed by vomiting, and was obliged to go to bed. He was very restless that night, and evidently feverish. He was constipated, and complained of loss of appetite, bad taste in the mouth, and his tongue was coated and dry.

On admission, the patient, who was very stout, presented a red, much swollen, markedly erysipelatous face. His temperature was 107° F.; in the evening the thermometer registered 104° F.

The next morning he was very restless, nauseated, tongue swollen and blistered. Temperature 107° F. His urine was cloudy, orange-coloured, acid, specific gravity 1020; it contained a considerable amount of albumen, and the microscope showed hyaline and granular casts.

8th. Complained of pain in back and limbs. The erysipelas spreading. Temperature 104° F.; pulse 146 per minute; extremely delirious. Tongue dry and very much furred. His hands were cyanosed.

9th. Very restless and delirious. Respirations had become stertorous during the past night; face livid and swollen. The urine was of a light claret colour, acid; specific gravity 1018, and contained about one-sixth its bulk of albumen. Died at 8.15 A. M.

Post-mortem examination, by Dr. Longstreth.—*Cavities.*—The *peritoneum* was injected, but without lymph. Many old adhesions of the *pleura*. The *pericardial* sac contained a little clear serum; the vessels on its surface were injected.

Heart.—Its right side was relaxed, and filled with blood and clots; its left side was contracted. Both the aortic and mitral valves showed morbid changes; the anterior flap of the mitral was thickened, and two of the aortic leaflets were adherent for a short distance near their insertion, and were thickened and opaque at deeper portions, and thinned in places near their free margins, almost to perforation. These changes were of old date. The whole of the endocardium of the left ventricle was thickened and opaque, and the left ventricular wall was hypertrophied.

The *spleen* was large; it showed several old infarctions of small size.

The *liver* was enlarged, moderately firm; its surface granular.

The *kidneys* were large, swollen-looking, smooth on the surface, and of regular outline. The stellate veins were very conspicuous, the capsule was tightly adherent and thickened. The cortical portion of the organ was much increased in thickness; its tissue presented a mottled, opaque aspect. The organs had a strongly urinous odor.

A microscopical examination of the kidney showed its tissues to be very much swollen. Its capsule, which in the fresh condition was tightly stretched over the swollen organ, and firmly adherent to it, was seen separated from its surface, and retracted at the sides of the section. The capsule was thickened, and composed of firm connective tissue; its vascular supply was inconspicuous, but its lymph spaces were large, and filled with granular and fatty matters, and some blood corpuscles. The larger vessels were enlarged, and their coats thickened, especially the outer coat; the muscular was highly granular, and its striæ indistinct. The Malpighian bodies were mostly large and swollen-looking; their capillary tufts appeared distended with blood corpuscles, but were greatly

obscured by the granular cell elements around them. Their capsules were thickened and swollen, and were composed of firmer connective tissue than normal. They were pressed upon, and even indented, by the swollen tubes and tissue around them.

The convoluted tubes were irregularly dilated, and their basement membranes thickened and swollen. Their epithelium was highly granular and fatty, the nuclei invisible, and the outlines of the cells very indistinct; so swollen were the cells that they apparently closed the lumen of the tube. Many of the tubules were filled with blood-clots, in which, however, the blood corpuscles could not be distinguished. So frequent was the occurrence of these hemorrhages, that under the lower power (1 inch ob.) in many fields of the microscope, four or five tubes thus filled with blood could be counted.

The connective tissue between the tubules was markedly swollen and loosened, yet its amount and its firmness were increased above the normal. The swelling of the tissue was so great, and the presence of cellular and blood corpuscles so abundant, that it was not possible to state whether contraction of the organ had taken place previously to the acute process. No collapsed or shrunken tubules could be made out.

The capillaries were everywhere distinctly visible by their contents of blood corpuscles. These corpuscles varied in amount from a single row to masses consisting of several rows distending the vessel till it equalled the size of the tubule itself. The filling of the vessels equalled the picture presented by the most complete artificial injection.

Microscopical Examination of the Renal Ganglia.—The connective tissue covering the ganglionic mass was decidedly thickened, swollen, and firmer than normal; its vascularity was moderately increased, and considerable adipose tissue was present in it. It was firmly attached to the mass, and was encroaching upon and surrounding the ganglionic cells at the periphery; it was more abundant than normal around the nerve trunks, and penetrated with them into the interior.

The ganglionic cells were irregular in their outline, and generally did not show their structure with clearness and distinctness. Their substance was markedly granular, only slight fatty changes were visible, and the pigmentation was not conspicuous. In many of the cells the nucleus was obscured by the surrounding granular changes, but the nucleolus was distinct, appearing as a black outlined spot.

The connective substance of the ganglion presented a swollen, highly granular, and striated appearance, and was increased and firmer than usual, and the ganglionic cells appeared partitioned off in groups by bands. This tissue contained a considerable number of rounded and elongated cells, but they were in a highly granular condition, and stained but poorly. There was seen to be some retraction of the tissue around the ganglionic cells, yet the spaces were not wide, and frequently contained granular material or small granular cells. The nuclei of the ganglionic cell-walls showed in some cases very distinctly.

The capillaries in the interior of the ganglia were conspicuous, and usually filled with blood corpuscles; in many cases they appeared of large size, and over-distended; but others were seen which had thickened tissue around them, and were evidently shrivelling; no hemorrhages were visible.

This patient was admitted with a severe attack of erysipelas, from which alone it is not probable that he would have succumbed had his

organs, especially the kidneys and liver, not already been affected by morbid changes. The urine contained a very considerable amount of albumen, and the microscopic examination of it, made only once, showed cylinders of a clear glassy appearance, inclosing, however, very many small granules. It is probable, from the colour of the urine, and condition of the kidney as exhibited by the microscope, that on the last day blood and epithelial casts would have been found.

The microscopic appearances of the kidney, taken in connection with the drinking habits of the patient, show that the organs were diseased prior to the attack of erysipelas, and this change consisted in a slight alteration of its vessels, and an increase of its connective-tissue constituents. It is probable, also, that the epithelium was also affected, as the renal phenomena were in excess of those usually seen in cases of uncomplicated erysipelas, though albuminuria of moderate or slight amount is the rule in this condition.

In the renal ganglia the changes were of moderate degree. The ganglion cells were granular, but not fatty. The connective tissue was increased in amount, and firmer than usual, but the cells of this tissue showed but slight active changes. The vascularity of the nervous masses was increased.

Case VII.—James E. K., coloured, æt. 29, was admitted March 25, 1878. The patient had suffered from intermittent fever many times during his life, but was never confined to bed by the disease; and did not think his general health was materially impaired thereby. During the last year he had been perfectly free from it, and had been well until five weeks before coming to the hospital, when he noticed a change in the secretion of the urine, and that he passed apparently more than usual; he became dull and listless; had some headache. Two weeks later his eyelids and face began to swell, afterwards his lower extremities, and finally his whole body became œdematous.

The urine was of pale yellow colour, acid, sp. gr. 1017; with heat and nitric acid there was precipitated about two-thirds its bulk of albumen. The microscope showed granular, epithelial casts in great number, and some hyaline and blood casts, together with free blood corpuscles. On the 1st of April he suffered from severe pains in both shoulders with increased temperature (104·5° F.), also from great tenderness to pressure over nearly the whole body, and severe pain in the lumbar regions. The general œdema decreased, and the pains lessened. On April 8th there was a failure in the secretion of urine, and shortly afterwards an abundant effusion occurred in the pleural cavities and pericardium. On the 17th of April the right leg was red and painful, and a day or two later it presented the appearance of erysipelas; subsequently an abscess formed at this part, and on two occasions large amounts of pus were withdrawn by aspiration. He gradually lost strength, the dyspnœa increased, respirations were 40 per minute. The condition of the urine remained about the same, the casts later were mostly granular and fatty. The patient died May 11, 1878.

The *autopsy* showed a large amount of inflammatory effusion in the *left pleural cavity;* over the upper part of the lung the pleural surfaces were

firmly adherent. The *right pleural sac* held less inflammatory material than the opposite side, but the lower lobe of this lung was markedly compressed. The *pericardium* contained a large quantity of serum and lymph. In the *abdominal cavity* was considerable serous effusion, but the peritoneum showed no evidences of inflammatory action. The valvular apparatus of the heart was normal, and its muscular tissue presented no marked alteration, except at the pericardial surface.

The kidneys were large and swollen; their outline was regular and their colour pale. The general appearance was such as usually characterizes the second stage of acute Bright's disease of the catarrhal type.

The other organs showed nothing especial to notice.

Microscopic Examination of the Kidney.—The surface of the *kidney*, as seen in the microscopic section, is smooth and regular. The capsule presented a swollen, loose appearance, but there was no increase in the firmness or the amount of its connective tissue. Its vascularity was not augmented; its lymph spaces contained considerable granular matter.

The lumina of the large vessels at the base of the pyramids showed smaller openings than usual, and were evidently pressed upon by the swollen tissue around them. Their internal coat was much folded and puckered, but the middle and external coats were not altered, except by a moderate swelling of the connective tissue at the periphery of the vessels. The Malpighian bodies appeared swollen and enlarged; some of them showed their capillary tufts injected, others were empty and their cellular elements were highly granular and fatty. Their capsules were swollen and wider than normal, but the connective tissue was loose, and not increased in amount; in some were present granules and fatty matter.

The epithelium of the convoluted tubes was generally highly granular and fatty, and so swollen that it nearly or quite closed the tube; in other tubes, a much smaller number of the epithelial cells presented more nearly normal conditions, and were evidently newly developed, having relatively large nuclei. The nuclei of the majority of the cells were greatly obscured by the granular and fatty changes which had taken place. Many of the tubes were clogged with granular and fatty debris. The basement membranes of the tubules were everywhere swollen and irregularly distended, and the interspaces between them were widened and the connective substance highly granular, but not increased in amount or firmness. The capillaries in many parts were injected with blood corpuscles, but in other parts were empty, the one or other conditions depending on the presence or absence of the swollen cells within the tubules.

It was evident from a general survey of the cortex that its thickness was increased, and that this swelling was so great that the capsule was much stretched. In some parts of the cortex the acute process had subsided, and the degenerated epithelium of the tubules was being replaced by new elements; in other portions the tubules were still clogged by degenerating cells and inflammatory products. In some parts the circulation was returning to its normal condition, or was even in excess, and in others it was hindered by the morbid condition of the tubular epithelium and of the adjacent parts. In the tubes of the medullary cones numerous fatty and granular casts were seen occupying a portion of their length; in this part the bloodvessels were greatly overfilled with blood, and here, too, the connective tissue between the tubes was swollen.

Microscopic Examination of the Renal Ganglia.—The connective tissue surrounding the ganglion mass was comparatively of small amount, loose

in character, and slightly connected with the nervous tissue, and was much less firm and coarse than in most of the other cases. It appeared somewhat swollen and œdematous, and where it passed into the substance of the ganglion around the bloodvessels, or accompanied the nerve trunks especially, its cellular elements were increased. There was also an increased amount of adipose tissue found in it.

The ganglionic cells showed distinctly and clearly, unobscured by the changes around them, or in their interior. Many of them exhibited double nuclei and nucleoli; about two-thirds of the cells presented no alteration, except an increased granular change with an occasionally visible fatty granule, whilst the other third were markedly granular and fatty, especially around their single nucleus, which, in these instances, was nearly or quite invisible.

The tissue of the ganglion had a finely granular, somewhat striated appearance; at no part were there any coarse fibres, or any penetration of the ganglion mass by the ingrowth of connective tissue bands from its capsule. The basis substance showed a moderate number of small round cells scattered through it, and a fewer number of elongated ones. There were no cleared spaces around the nerve-cells as witnessed in other specimens. In general, the aspect was that of an evenly spread basis substance, having numbers of small round or spindle, strongly stained cells scattered through it, and in which the plump and regularly rounded ganglion cells rested as in a bed. Vascularity and injection of the vessels, both at the periphery and in the interior, were deficient in a very striking degree.

This patient suffered from catarrhal (parenchymatous) nephritis, which in the early stages was of a mild type and rather slow in its advance. The symptoms were noticed five weeks before his admission to the hospital, and during this period he was without proper care. The progress of the disease was unfavourable, being complicated with pericarditis and pleurisy and with abscess of the leg. At the autopsy the kidney presented the appearances usually seen in the large white kidney of Bright or in Grainger Stewart's second stage of acute nephritis. The microscopic examination of the organs showed a swollen condition of the connective tissues. The vessels and the connective-tissue portions of the organ showed only such alterations as are dependent on acute disease. The epithelial cells of the tubules were highly granular and fatty, and to these elements the morbid changes were principally confined. The casts in the tubes were of the same character as those in the urine during life. The ganglion cells in this case were comparatively little altered; in the connective substance of the nervous masses, there was no fibrillation of the tissue, and the cellular elements of this part were but little increased in numbers and showed but slight hyperplastic or formative changes.

CASE VIII.—Sabilla R., æt. 16, coloured, single, domestic, admitted to the Pennsylvania Hospital January 26th, 1878. The patient had always been healthy until two years previous, when she had an attack of rheumatism, affecting the ankles and knees; this attack was not so severe as to confine her to bed, but since she has noticed slight palpitation of the

heart from exertion. The previous winter she has been much exposed to cold and wet. Nine days before her admission slight pains in the ankles began, and six days ago almost every joint of the body was painful, and in addition she has had pain in the cardiac region and dyspnœa, and has gradually grown worse.

On admission, her temperature was 105° F., pulse 136 per minute, respiration 72, panting and shallow. There was some pain and a little swelling of both hands. Owing to the rapidity of the heart's action, its physical examination was difficult and uncertain; there seemed to be an apex systolic murmur and a friction sound over the body of the heart, confined to a very small area. The heart appeared displaced.

Urine note. Jan. 27.—Cloudy, acid, sp. gr. 1010, albumen in small quantity. The microscope showed pus (?) corpuscles, squamous and pavement epithelium, and a few granular and hyaline tube-casts.

The patient gradually sank and died Feb. 5th, death being preceded by marked evidence of a pulmonary complication.

Post-mortem examination, by Dr. Longstreth.

Cavities.—Considerable serum was found in the *abdominal* cavity, containing large masses of fibrin. No evidence of peritonitis. The *pleural* cavities showed numerous old and recent adhesions, serum and flocculent lymph, especially at right base.

The *pericardium* was distended with serum and recent lymph; the lymph was half an inch thick, pretty firm in character and adherent to both the surfaces.

Heart.—The right side distended, the left firmly contracted. Both the mitral and aortic valves showed numerous recent vegetations of small size along the line of contact of their leaflets, which were swollen and opaque. The heart weighed 12 ounces av.; its left ventricular wall measured $\frac{3}{4}$ inch in thickness.

The *lungs* were compressed by the pleural effusion, and there were areas of pneumonic consolidation in the right lower lobe.

The *spleen* showed several small, recent embolic patches.

The *kidneys* were not much enlarged, appeared swollen, and were of doughy consistence. The capsule was slightly thickened and more firmly adherent than normal, but on removal left a smooth surface, showing the stellate veins distinctly. On section, the cortex was swollen and increased in thickness. It was homogeneous looking and opaque.

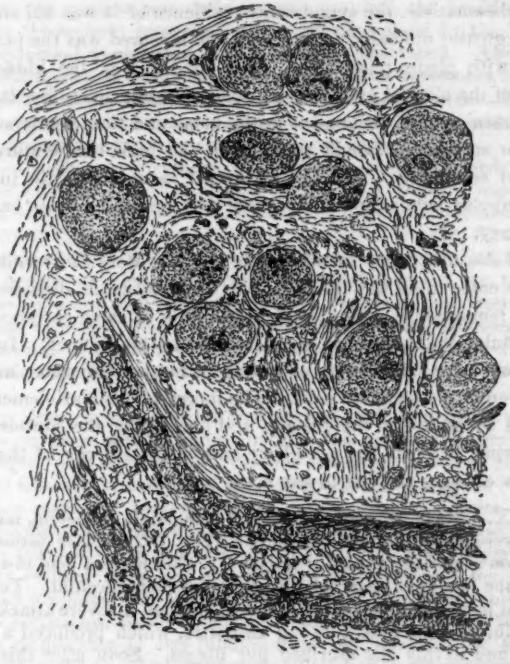
The microscopic sections of the kidney from this case were lost, and a particular description of it cannot therefore be given. The condition present was that of cloudy swelling of the tubular epithelia and also an increase of the intertubular connective tissue. The microscopic examination was carefully made at the time of the autopsy, but as the specimens were lost we have only appended this short note of the condition of the kidney.

Microscopical Examination of Renal Ganglia.—The connective-tissue covering of the nervous mass was considerably thickened, composed of firm bands, swollen and contained considerable adipose tissue. The vessels in it were larger and more numerous than normal, their coats thickened, especially the muscular layer, but they were empty of blood.

The ganglionic cells were pretty regular in their outline, though perhaps generally less so than those represented in the drawing; many were quite irregular, looking notched and shrivelled. They were mostly highly granular, and many showed fatty changes. The nucleus was as a rule dis-

tinct, although obscured by the changes in the cell-body; but occasionally it was either quite invisible or some portion of its outline was lost. In some of the nuclei black granules were present. The nucleoli showed distinctly as black outlined circles or as black dots.

Fig. 4.



The cells are regular in outline, show much granular change and a few fatty particles. The connective substance is swollen and firmer than normal, and only a few new elements are present. The arteriole has its muscular coat hypertrophied and the connective tissue around it is increased. × 350.

The connective substance of the ganglia presented a loose, swollen appearance, its fibres were moderately coarse and loosely collected, but they passed band-like through the nervous mass and partitioned off the cells more or less completely into irregular aggregations. Its tissue was highly granular in places, in other parts between the fibres was a hyaline basis material, which, especially around the vessels, gave an appearance not unlike myxomatous degeneration, although the condition was evidently not of such character. A moderate number of cells were present in it, both rounded and elongated, which stained but poorly and were mostly granular and fatty. The vascularity of the ganglia was obviously increased. Numerous capillary vessels were present having thick swollen walls or surrounded by an increased amount of connective tissue. Some of them were dilated, others were collapsed. They were empty of blood, and no hemorrhages were seen.

We think it may be concluded that the clinical record of the urine shows that the patient had suffered from renal disease previously to the time of her admission with the acute illness of which she died. In fact, it was a question during life whether the pericarditis and pleurisy were not of renal origin. Although the patient's story on admission indicated an acute attack of rheumatism, the symptomatic evidence of it was not strong, and by far the greater difficulty under which she laboured was the pericarditis, combined with pleuro-pneumonia. The condition of the kidney is confirmatory of the clinical evidences of renal disease prior to her last illness. That albumen should be present in the urine and that cloudy swelling of the tubular epithelium should result from the high temperature are not unexpected conditions. But the thickened capsule and the increase of the intertubular connective tissue show that previous disease had existed in the kidney.

Some of the alterations found in the ganglia were the results of such changes as come to all the tissues of the body in acute diseases attended with high temperature. The swollen condition of some portions and part of the granular changes are to be interpreted in this manner. In addition to these, we have irregularity of outline, a marked granular and a fatty degeneration of the ganglion cells. The increased cellular elements in the connective substance of the ganglia and increase of the fibrous and connective tissue, both in the periphery and in the interior of the nervous mass, show changes not due to any acute process.

CASE IX.—Mary W., æt. 26, coloured, married, domestic, admitted to the Pennsylvania Hospital, November 12th, 1877. Her father died of consumption; her mother of "dropsy." The patient had always been healthy; she had been married six years and had one child. Two months previous to her admission to the hospital, she had a severe attack of "biliousness," for this she took a strong cathartic, which produced a very free diarrhœa, and to this she ascribed her illness. Soon after this time she began to complain of malaise, headache, loss of appetite, and nausea, all of which gradually increased, and during the latter part of the month prior to her admission she was compelled to give up her work. About this time, she had a continual diarrhœa, and a cough began, attended with abundant mucous expectoration, which soon became blood-stained. Up to the time of her admission she had had no œdema of the feet or other symptoms of kidney disease; she had previously been much exposed to cold and wet.

On admission, there was considerable fever, no hebetude, tongue coated with moist whitish fur. Abdomen not tympanitic, considerable diarrhœa, the passages of a very fetid character, no vomiting. Cough with bronchitic blood-stained expectoration, resonance over both lungs not impaired, mucous râles on both sides posteriorly and on the left anteriorly.

Urine, clear, yellow, acid, specific gravity 1021. Albumen in small amount and numerous granular and hyaline tube-casts.

14*th*. Temperature 105° F.; some dyspnœa. Impairment of resonance at right base, other phenomena the same.

16*th*. Expectoration contained more blood. Hebetude and subsultus tendinum.

18th. Expectoration less bloody. Diarrhœa and other phenomena continued the same. Subsultus increased. Slight delirium. Urine scanty. Temperature 105½° F.

19th. Urine contained one-eighth albumen, specific gravity 1020. Large amount of epithelial cells and granular tube-casts and some free oil globules. Subsequently, the condition of the urine was not to be accurately determined, as the patient was delirious and emptied the bladder involuntarily, but the amount increased. The physical signs in the lung indicated a catarrhal pneumonia. The diarrhœa continued. The diagnosis was typhoid fever and catarrhal pneumonia. Died, November 24th, 1877.

Post-mortem examination, by Dr. Longstreth.—*Cavities.*—The *peritoneum* was smooth, no increase of serum and no lymph or recent adhesions. The *pleura* and *pericardium* showed nothing especial.

Heart.—Right side distended and relaxed, and contained large firm clots; the left ventricle flabby and empty, and slightly dilated. The mitral valve showed a spot of atheromatous degeneration, and the commencement of the aorta showed similar changes. Weight, 8½ ozs.

The *lungs* showed the characteristic changes due to catarrhal pneumonia. *Spleen* was small, its consistence flabby, pale, its tissue soft. *Liver* was swollen, moderately congested, its tissue less resistant than normal, and appeared opaque and homogeneous (cloudy swelling). *Intestines.* Several of Peyer's patches were deeply excavated. The mesenteric glands near by were enlarged and surrounded by an area of congestion.

Kidneys large, smooth, swollen looking, and their consistence was flabby. The veins on their surface conspicuous. The cortex was greatly thickened, opaque, and mottled; the capsule somewhat swollen, easily separated, and leaving the surface of the organ smooth and regular. The kidneys had a markedly urinous odour. Their structural parts presented microscopically nothing of note, except the tubules and Malpighian bodies.

All the parts of the organ were much swollen. The Malpighian tufts, with their cellular elements, closely filled the capsules; the cells were very highly granular, and prevented the recognition of the capillaries. A few blood corpuscles, however, could be distinguished in the tufts. The basement membranes of the tubules were swollen, and the tubes were irregular in outline. The epithelial cells, mostly retained in position, were very highly granular and fatty, and so swollen that they nearly filled the lumen of the tube; their nuclei were generally invisible. Many tubes were clogged with granular and fatty matters, or oil globules.

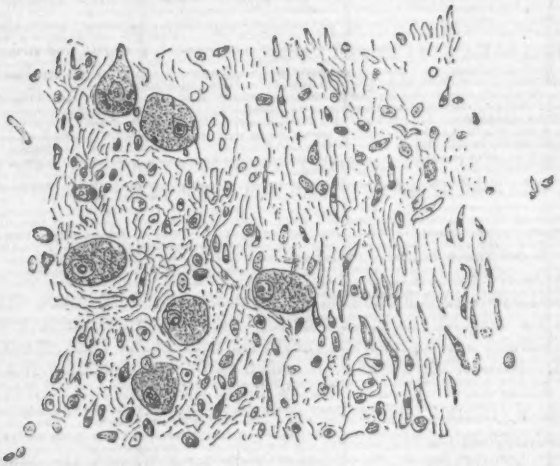
Microscopic Examination of Renal Ganglia.—The connective tissue envelope of the nervous mass showed little or no evidence of any abnormal condition. It was composed of fine, loosely matted fibres, devoid of adipose tissue; it exhibited no abnormal vascularity, nor its vessels changes of their coats. There was no increase of connective-tissue cells, and no increase of connective tissue about the nerves either along their trunks or at their entrance, or within the ganglia.

The ganglion cells were distinct, of regular outline, and showed but little evidence of structural changes. Their bodies were mostly free from granular or fatty alteration, and but little pigment was noticed within them. Their nuclei were always distinctly seen, although in numerous instances a few granules were seen within them or on their border. The nucleoli were clear and shining.

The connective substance of the ganglia was considerably altered,

though to a very much less degree than in any of the other cases. It was composed of a clear, transparent, very slightly granular and barely visible finely striated basis substance, in which were seen a considerable number of mostly elongated bodies and a few rounded cells. These elements were exceedingly delicate in their character, and not granular or fatty; they stained distinctly though not deeply. The nervous masses showed no aggregation of the ganglion cells, and no appearance of being partitioned off by bands or masses of connective tissue as was so distinct in many of the other cases. Doubtless many of the bodies depicted in the drawing were nerve fibres, and the cellular bodies were evidently of a recent character and exhibited no progressive changes. The whole structure was much more delicate than in the drawing.

Fig. 5.



The nerve-cells present more nearly normal aspects. The connective basis substance of the ganglia does not show any very distinct alterations; the cellular elements are increased, but some of those bodies are probably nerve-tubules and not new morbid products. × 350

From the history of the case, the pathology of the attack is not entirely clear; that she had typhoid fever, and that this was complicated with a catarrhal pneumonia, is quite evident. Whether the renal disease was of prior date, or whether coincident, is very uncertain. We are of the opinion that the kidney disease was of recent date. The fatty changes of the renal epithelium were probably produced through the influence of the profound blood changes due to the typhoid poison.

The renal ganglia were little altered, the principal appearance to be regarded as abnormal was in the connective substance of these bodies, and these changes were of recent origin, and they were very slight.

In group III. the type of disease is different from the cases in both the previous groups; albuminuria is a marked phenomenon, and the renal disease was not advanced, yet probably the immediate cause of death, except

in the last case. In Case VI., suffering from erysipelas, the evidence of pre-existing renal disease is plain. The condition of the kidney, as seen by the microscope, shows that interstitial changes had occurred previous to the incoming of the acute parenchymatous disease accompanying the erysipelas. These interstitial changes were not of such character as to produce contraction of the organ, or, at least in the presence of the tubular alteration, the contraction had been overcome and was not visible; the increase of intertubular connective tissue was however sufficient to markedly interfere with the renal functions, and this attack, which but for this condition, would probably have had a favourable issue, resulted in death. In Case VII. the history and the condition of the organs show a type of disease different throughout from any of the previous cases. The alterations in the kidney are those of acute catarrhal inflammation; there is slight disease of the bloodvessel walls, but no evidence of chronic interstitial changes. The case was complicated, however, with inflammatory disease of the serous membranes, phenomena much more common in connection with the contracted kidney than with kidneys presenting the type of disease which these organs exhibit. In Cases VIII. and IX., the evidence of kidney disease prior to the fatal attack is much less than in any of the other cases; and in Case IX. it can with great certainty be concluded that no renal mischief was present previous to about a fortnight before admission.

In this group, the changes in and about the ganglia were much less marked, or in some cases so slight as not to be appreciable; the connective-tissue increase and the accumulation of fat, both here and around the kidney, were noticeable conditions, and in respect to the ganglia is shown by the microscopic examination. In this group the ganglion-cells were markedly granular, but the absence of fatty degeneration separates the cases very distinctly from those in the previous groups. The condition of the connective basis substance of the nervous masses conforms to a recent hyperplastic alteration of this tissue, and corresponds to the recent or slightly marked changes found in the ganglion cells and with the type of the renal disease in this group. The vascularity here is likewise in correspondence with the tissue alterations.

In Case IX., the connective tissue alterations are very slight and are those due to acute conditions. The ganglion cells likewise show little alteration, and the basis substance is devoid of any evidence of contractile changes such as were seen in most of the previous cases.

We have thus, we think, by a series of cases arranged in different groups according to the prominence of the changes, proved that in Bright's disease the renal ganglia are materially altered, and we refer to the drawings for a verification of the statement.

The difficulty of the inquiry was considerable. We have searched carefully the sources from which we expected to derive information con-

cerning the microscopic appearances presented by the ganglia, without, however, obtaining much knowledge. A great deal has been written on the structure of the ganglionic cell, its nucleus and nucleolus, its nerve fibres, and its connection with the spinal system of nerves, as well as the fibres distributed from it, as a centre, to the various organs; and in giving our description of the condition of these bodies, the typical form, as shown by Bidder,[1] Arnold, Fräntzel,[2] Lubimoff,[3] and others, has been carefully held in view. But of the normal appearances presented by the tissue of the ganglia lying between the ganglionic cells, and in which these bodies rest as in a bed, and through which the nerve fibres pass to be distributed peripherally, we have found no satisfactory description and no plates which represent the normal condition. Key and Retzius,[4] however, have shown very beautifully the lymphatic spaces of the ganglia, and Ranvier[5] has studied minutely the condition of the nerve fibres. Of the pathological conditions of the sympathetic nervous system, Poincare and Bonnet[6] have described the changes occurring in general paralysis, Voisin[7] in certain psychical disturbances connected with disease of the abdominal organs, and Petrow[8] in constitutional syphilis. Lubimoff[9] has made the most extensive studies of the general morbid conditions occurring in the various divisions of the grand sympathetic and in the component parts of the sympathetic ganglia. Yet none of these authors, or any others who have worked in this field of research, have traced out any definite connection, in the relation of cause and effect, between the ganglionic changes and the morbid condition of any organ to which the affected ganglion stands in the relation of a nerve centre. Among the 250 cases in which Lubimoff examined the condition of the sympathetic, he mentions only two of kidney disease (nephritis diffusa), but gives no details of the cases or of the appearances presented by the ganglia, and does not connect the nervous changes directly with the renal disease. Our endeavour has been to discover whether anatomical alterations are to be found in the

[1] Die Nervi Splanchnici und das Ganglion Cœliacum. Arch. f. Anat., Physiol. und Wissenschaftl. Med., 1860, s. 472.

[2] Beitrag zur Kenntniss von der Structure der spinalen und sympathischen Ganglienzellen. Virchow's Arch., Bd. xxxviii.

[3] Embryologische und histogenetische Untersuchungen über das sympathische und centrale Cerebrospinal-Nervensystems. Virchow's Arch., Bd. 60 s. 217.

[4] Studien in der Anatomie des Nervensystems. Arch. für Mikroscopische Anatomie, Bd. ix.

[5] Recherches sur l'histologie et la physiologie des nerfs. Archive de Physiologie Normale et Pathologique, 1872.

[6] Recherches sur l'anatomie pathologique et la nature de la paralysie générale. Annales médico-psychologiques, 1868, p. 185.

[7] L'Union Med. 1872, No. 54, p. 650.

[8] Ueber die Veränderungen der sympathischen Nervensystems bei constitutioneller Syphilis, Virchow's Arch., Bd. lvii. s. 121.

[9] Beiträge zur Histologie und pathologischen Anatomie des sympathischen Nervensystems. Virchow's Arch., Bd. 61, s. 145.

particular part of the nervous system directly connected with the renal apparatus, and what is the nature of this alteration.

We think it cannot be denied that a morbid condition hitherto not described has been shown to exist in the ganglia—a condition to be seen as distinctly with the unassisted eye as the abnormality of the kidneys themselves, and the microscopic examination of the ganglia has confirmed the existence of the changes and has shown that the histological alterations have been in some degree proportional to the amount and the duration of the kidney disease.

The question is then no longer as to the change, but as to its meaning. Is it simply consequence? is it part of a general degeneration which affects kidney and other parts of the body; or is it the starting point of the kidney disorder? Is it concomitant, is it cause? We do not think it consequence, for the alterations are discernible in the ganglia before any other tissues, except the kidneys, are markedly affected. Whether concomitant or cause is very difficult to answer. But we believe that it will be found to be the latter, at least for some of the forms of Bright's disease, and that the changes, especially in the type of the disease called interstitial nephritis, or contracted kidney, will be recognized to be linked to the changes we have indicated in the ganglionic cells, in the connective tissue and in the bloodvessels. Whether all forms, or to what extent the varied acute and chronic conditions classed under Bright's disease present these ganglionic changes and are dependent upon them, is a matter for future research; and we may, through this research, find an additional means of clear distinction between the renal maladies.

Speaking generally, and having more particularly the interstitial nephritis in view, we think that the physiological pathology of Bright's disease is to be interpreted in the following manner: the specific cause, whatever may be its unknown form or character, acts in such a manner on the ganglion cells, presiding as centres of innervation to the kidneys, and whose fibres distributed to the vessels of these organs regulate not only the calibre of the vascular trunks, by changing the state of contractions of their muscular fibres, but also probably the conditions of osmotic action between the blood and the renal tissues, that the collective phenomena, known as Bright's disease, are brought about. In the form of interstitial nephritis these phenomena present themselves as a condition of inflammation of the connective-tissue portions of the kidney, and with this change, we see the alterations of the muscular fibres of the arterial walls. The subsequent lesions in the kidney are the results of the further development of the inflammatory products and their cicatricial contraction, and are not the special effect primarily of the morbid condition of ganglion cells. The alterations of the connective basis substance of the ganglia, are probably of the same nature as the hyperplasia of the connective tissue of the kidney, and like this tissue, it undergoes similar developmental

changes and finally contraction, which latter morbid process reacts on the ganglion cells, producing further degenerative changes in these bodies. The early stage of the active, hyperplastic, process of the connective tissue of the ganglia, attended, as we have shown it to be, by increased vascularity, produces an irritative condition of the ganglionic cells which reinforces the original active cause of the disease.

We cannot bring this paper to a conclusion without referring to two points which have an almost self-evident bearing on the affection we have shown to exist in the sympathetic ganglia; one is the condition of the minute vessels, both in the kidneys and elsewhere, which has attracted the attention of so many observers; the other, the yet more commonly known hypertrophy of the heart that is found in connection with Bright's disease.

With reference to the condition of all the smaller arteries of the kidney, when this organ is contracted, when, therefore, it has suffered from interstitial nephritis, all authors are agreed that thickening of the walls is present. Some observers, as Gull and Sutton, state that the thickening is due to a "hyalin-fibroid substance," deposited "chiefly outside the muscular layer." George Johnson, on the other hand, had previously affirmed that the thickening is due to a true hypertrophy of the muscular coat of the vessels. These authors have shown that a similar change affects the arteries of other organs of the body. Many observers have confirmed the existence of thickening of the arteries of the kidney, and have ranged themselves on one or the other side in reference to the nature of this change. Gull and Sutton differ materially from George Johnson in relation to the extent or parts of the vascular system involved in the change; their theory they have named "arterio-capillary fibrosis," implying by the name that the capillary vessels show the hyalin-fibroid changes as well as the small arteries, while Johnson's view necessarily limits the change to the arteries, which alone have muscular fibres in their wall.

From our own observations we have no hesitation in concluding, as is shown in the description of our specimens of this series of cases, as well as from the examination of very numerous other cases by comparison with healthy arterioles, that in cases of contracting kidney, the muscular tunics of the vessels are hypertrophied, especially and invariably in the kidney, and also in other organs of the body, even when the process of contraction is not far advanced. But we do not wish to enter into the discussion of this question, contenting ourselves with the statement just given of our belief concerning the true condition of the arterial changes—an opinion formed long previously to the investigations with which we are at present concerned. We wish, however, to point out the causal relations which we believe the muscular hypertrophy of the vessels has to the alterations found in the ganglia.

We do not think it rational to suppose that the muscular fibres contract,

for the purpose of lessening the supply of blood to the damaged kidneys, or for any other reason, from any power inherent in themselves. Such a notion implies a degree of intelligence or self-originating action which has never been attributed to muscular fibres, either of the voluntary or involuntary set; and, it seems to us, it is illogical to confer upon the muscular coats of the arterioles a power of self-action, which, in case of contracted kidneys, is sufficient to determine a substantial hypertrophy. The cause of this hypertrophy must be sought, since such action of the muscular fibres is not a voluntary one, in the ganglionic centres. Evidently the causal conditions must be general ones, because not only are the effects seen in both kidneys, but in many instances the vessels of other parts of the body are influenced; they must be causes that act on not only the renal plexus in particular, but also on the other ganglionic centres. One cause may be of such a nature that it operates through the general nervous system, for it is a well-ascertained fact that grief, and sorrow, and nervous depression are potent sources of Bright's disease, especially of the contracting kidney. Again, the disturbance may come through the blood; for the nutrient fluid supplying the renal plexus, if altered, will produce a condition of irritation of the ganglionic cells, with subsequent tissue-changes alike in the ganglia and in the kidneys, and give rise to the phenomena of interstitial nephritis—hyperplasia of the connective tissue, and hypertrophy of the vessels. We regard, then, both the tissue-changes and the hypertrophy as essential and connected parts of the same picture. Both conditions are presided over, and directed by, the sympathetic or vaso-motor centres.

Let us consider, in the next place, the hypertrophy of the left ventricle of the heart in its relation to these vascular changes, and also the place which this hypertrophy holds with reference to our theory. Hypertrophy of the heart, coexistent with chronic renal disease, was first alluded to by Bright in the first volume of *Guy's Hospital Reports*, and he expressed the opinion that the ventricular hypertrophy was due either to the direct action of the altered blood on the heart muscle or to the effect of this fluid on the minute and capillary circulation, so as to render greater action on the part of the heart necessary to force the blood through the distant subdivisions of the vascular system. Since Bright's time most pathologists have consented to this view of the causation of the cardiac hypertrophy, and have agreed that it was present in the majority of cases. But from the time that an essentially different pathological condition has been shown to exist in contracted kidneys and in the large white kidney, it has been pointed out that in the latter form of chronic Bright's disease the ventricular hypertrophy is exceptional.

Johnson was the first to offer a consistent theory for the cardiac hypertrophy with contracted kidney, founded on a physiological basis derived from a minute study of the anatomical parts. Gull and Sutton, while

denying the vascular hypertrophy, and thereby removing the antagonizing element which, according to Johnson's theory, is the cause of the cardiac hypertrophy, state that they "have particulars of nine cases in which the kidneys were very contracted and the heart was free from hypertrophy." Unfortunately, they do not refer us to the particulars of these cases. Johnson states that he has "observed a constant relation between hypertrophy of the arterial walls and hypertrophy of the left ventricle of the heart;" he also says that in the "majority of cases of contracted kidney the left ventricle is thickened," implying, therefore, that the cardiac hypertrophy is not invariable. In the waxy kidney, too, Grainger Stewart has shown that hypertrophy of the heart was present in only a small percentage of the cases.

We do not think that the heart hypertrophies simply, as has been assumed, because of the opposition the passage of blood meets with in the renal circulation. We are inclined to believe that the hypertrophy of both the heart and the vessels is to be traced to a central origin; in one case to the cardiac ganglia, and in the other to the renal. The same statement applies to the changes in the vessels and tissue in other organs of the body, and when they, in their turn, are affected, the ganglia which preside over them as centres most probably have been acted on in a similar manner as the ganglia already mentioned.

If cardiac hypertrophy invariably resulted from arterio-capillary narrowing, the change would certainly be vastly more common than it is. If simple narrowing were the cause, surely in the large white kidney the pressure on the capillary circulation is greater than in the early stages of contracted kidney, and therefore cardiac hypertrophy should be a marked feature of this form of chronic Bright's disease. Experience shows that it is not. In respect to the kidney itself, the secreting gland structure is just as much damaged, nay more so, in the large white kidney as it is in early stages of the granular kidney in which the vascular hypertrophy has occurred. There is, therefore, a deeper, a more remote origin of the vascular and of the cardiac hypertrophy; and we cannot but conclude that an essential difference in the pathology of the two forms of chronic renal disease exists in respect to their origin and, therefore, in respect to the cardio-vascular changes.

Further, it has been shown by Bamberger, that the cardiac hypertrophy occurs to a marked degree even in the early stages of contracting kidney or interstitial nephritis, before the kidney is much damaged; and this is, therefore, at a period of the disease when some other cause must be acting than the alterations of this organ or of its vessels.

That there should exist one case of hypertrophy of the vascular muscles in chronic Bright's disease with no cardiac hypertrophy, seems to destroy entirely the theory which Johnson has advanced; whereas, according to our belief of the central nervous origin of these hypertrophies, the occur-

rence of the two forms of hypertrophy is readily disconnected. The observations of Lubimoff furnish us with a direct anatomical basis on which to support this view. He relates many cases in which he examined all the principal ganglia, the cervical, the thoracic, and the solar, and found that the condition of the ganglion cells, the fibres, and the connective tissue differed in each centre respectively, even in patients dying of some general disease. One instance will serve for an illustration of this point; in a body of a patient who died of carcinoma of the pelvic viscera, with an extension of the malady to the general peritoneal surface, some of the ganglia of the solar plexus were diseased, not by an involvement in the new growth, while the superior ganglia showed nearly normal conditions. Similarly, we hold that the renal ganglia may be affected while the cardiac ganglia escape. That both are affected we believe to be the rule in cases of contracted kidney.

But we will not speculate any further in this matter. We had hoped to have furnished convincing reports of the state of the cardiac ganglia and their relation to hypertrophy of the heart. But our preparations thus far have not been fortunate, and we shall merely express our opinion that the cardiac ganglia exhibit changes similar to those described in the renal ganglia. Several other inquiries suggested themselves which we had desired to complete, such as an explanation from the point of view brought forward of the many nervous phenomena of Bright's disease, and of the state of the spinal cord at the origin of the filaments communicating with the ganglia. Yet we felt that we had arrived at results sufficiently distinct not to delay any longer the publication of what we had gained, and to invite others into the field for the benefit of the common cause.

In summing up our work, we think we have arrived at these conclusions:—

1st. That in Bright's disease, especially in the contracting kidney, there exists a constant lesion of the renal plexus.

2d. That whilst this lesion might be looked upon as forming part of a general process of degeneration, in connection with the kidney disease, we think it is the cause of the renal malady and precedes the degenerative changes.

3d. That the diseased condition of the ganglia furnishes the clue to the alterations of the vessels of the kidneys.

4th. That similar changes producing similar results may exist in other ganglia; for instance, in the cardiac plexus, explaining the hypertrophy of the heart.

ARTICLE II.

ON SIMULTANEOUS LIGATION OF THE COMMON CAROTID AND OF THE SUBCLAVIAN IN ITS THIRD PORTION IN THE TREATMENT OF SUPPOSED ANEURISM OF THE ARTERIA INNOMINATA, WITH A CASE.

By LEWIS A. STIMSON, M.D., Surgeon to the Presbyterian and Bellevue Hospitals, New York.

ON the 21st of November, 1865, Mr. Christopher Heath performed for the first time the operation of simultaneous ligation of the common carotid and of the subclavian in its third portion for the cure of innominate aneurism. The idea was not a new one, and operations for the same disease, closely allied or identical in principle and in the means by which the proposed effect was sought to be produced, had been performed during the preceding half century.

The principle of distal ligation in cases which do not admit of the application of a ligature upon an artery between the heart and the aneurism had been orally suggested by Brasdor, professor of surgery in Paris, as early at least as the year 1790, and the suggestion had been repeated in print by his contemporary Desault,[1] but neither surgeon had acted upon it; Brasdor, apparently, not having had the opportunity, and Desault refraining in a case of axillary or subclavian aneurism that came under his care through fear of causing rupture of the sac by the increased pressure which he supposed would be produced within it by the closure of the artery. The first operation upon this principle was performed October 2, 1798, by Deschamps,[2] who tied the femoral artery in the middle of the thigh for the cure of a large aneurism, the upper border of which was less than a finger-breadth below Poupart's ligament. Rupture threatening on the fourth day, another operation was determined upon; the artery was compressed against the pubis, the sac opened, and the vessel tied above and below. The hemorrhage was profuse, and the patient died in eight hours. Brasdor, who died shortly afterwards, was present at this operation, as were also Boyer, Corvisart, and six other consultants.

The second operation was by Sir Astley Cooper, who tied the common femoral below the origin of the epigastric artery for a large aneurism of the external iliac. The patient recovered from the operation, and the aneurism diminished in size, but it continued to pulsate and ruptured soon afterwards.

In 1809 or 1810, Mr. Wardrop saw in consultation a case of supposed aneurism of the innominate and the root of the carotid, and, being familiar with the facts above mentioned, proposed to tie the carotid artery. The proposal was not favourably received by the other consulting surgeons, and the patient was left to his fate, dying within the year. The condition

[1] Œuvres chirurgicales, third edition, edited by Bichat, vol. ii. p. 568.

[2] Desault, loc. cit. p. 572.

of the vessels disclosed at the autopsy is claimed by Mr. Wardrop, in his book on aneurism published in 1828, to have been curable by the operation he proposed, but as the aneurism proved to be of the ascending aorta and root of the innominate, and not of the innominate and root of the carotid as he had supposed, it seems likely that this claim was the result of his later experience.

It is interesting to trace the manner in which the Wardrop method of distal ligature, as we now understand the term, was developed: the method, that is, which proposes to cure an aneurism by slowing the current through it, not by arresting it entirely. Our knowledge of the method recommended by Brasdor is purely traditional, for he left no written account of it. Our conception of it, however, is the application of a ligature on the distal side of an aneurism with no intervening arterial branch between them. Whether or not Brasdor intended to restrict it thus to cases in which the circulation through the aneurism would thereby be completely arrested, is not known. Probably his idea was not very sharply defined in his own mind. It was known at the time that complete arrest of circulation was not necessary to the success of the Hunterian method by ligation on the proximal side, and, as Dr. Sands has well shown in a paper upon "The Distal Operation for the Cure of Aneurism of the Innominata,"[1] intervening branches did exist between the sac and the ligature in the first two operations undertaken in accordance with Brasdor's suggestion; and in the first case in which Wardrop proposed to try it the subclavian was supposed to come off from the aneurism itself or on its distal side, and he nevertheless speaks of it as Brasdor's operation. Writing seventeen years after he had made this proposal, and two years after he had successfully treated an aneurism of the common carotid by distal ligature, and shortly after his successful operation upon Mrs. Denmark (ligation of the subclavian in its third portion for innominate aneurism, the carotid being thought to be occluded), Wardrop claims that his success had established the principle contained in Brasdor's proposal, and explains the previously infrequent recourse to the operation by the fact that surgeons had taken too limited a view of its application, and had deemed the complete stoppage of the circulation a *sine qua non* to its success; adding that cases considered suitable under such a theory must have been extremely few. These are his own words, and it must be evident to any one who will read his book carefully and seek out the meaning of his sometimes obscure and carelessly framed sentences, that by the "new operation" which he recommends he means only a modification of Brasdor's to this extent, that in cases where a complete or almost complete arrest of circulation through an aneurismal sac was not possible he would try the effect of a *moderate* reduction in the rapidity of the current.

There is nothing in this view to detract from the credit due Wardrop.

[1] Medical Record, February 1, 1869, p. 531.

As we have seen, Brasdor only made the suggestion; Desault, with whom, as is claimed by some, the idea was also original, shrank from putting it into execution; Deschamps and Sir Astley Cooper did the operation unsuccessfully, and these failures were followed by a general discrediting of the principle. Allan Burns, writing in 1812, says of it: "I cannot conceive a more futile idea than to suppose that such an operation could possibly tend to prevent the growth of an aneurismal sac;" and again, "there is no point in the treatment of aneurism which should be more decidedly reprobated than this; it is absurd in theory, and experience proves that it is ruinous in practice." The warmth with which this opinion is expressed may have had its origin in the fact that Burns was employed in the case in which Wardrop first advised the operation and was overruled. It is not surprising that Wardrop took occasion to quote this opinion in connection with the record of his own subsequent successes.

In spite of this hostility and of these reverses, Wardrop accepted and adhered to the principle, and he did this not blindly but with an intelligent appreciation of facts disregarded by others. He had the courage of his opinion, he acted upon it, and he convinced others of its correctness. He established the principle, he was the real introducer of the method, and his is the credit.

Nearly fifty years had elapsed since the suggestion was first made, and at least twenty years since the two attempts to embody it in practice had failed, when Wardrop found his first opportunity. Fifteen years previously he had proposed the operation in consultation, and had been overruled; now the case was his own. The patient was a woman 57 years old, with a carotid aneurism of recent growth. Wardrop tied the artery on the distal side in June, 1825, and cured the disease. Six months later he repeated the operation in another case "in the presence of many practitioners," and again a year later he advised it and was present at its performance.[1] The publication of these cases was followed in 1828[2] by that of the fourth, in which the operation, also for carotid aneurism, was done successfully in September, 1827, by George Bushe.

Wardrop held that the results of these four cases proved the propriety of resorting to distal ligature when no branch intervenes between the ligature and the sac, and when ligation on the cardiac side is impracticable; and he argued, from certain observations made in the course of these cases, that it was often even to be preferred to the Hunterian method when the

[1] It is interesting to note that in the second operation he used an animal ligature, silk-worm gut, cut both ends short, and obtained complete union of the wound in three days. The patient died three months afterwards, apparently of kidney disease, and at the autopsy no trace was found of the ligature; the carotid was pervious throughout, and presented a "manifest dilatation a little more than an inch in length near its root, corresponding in position to the pulsating tumour that existed during life."

[2] Lancet, 1827–28, vol. ii.

latter was possible. He then went a step further, and this is what he calls the "new operation," and claimed that aneurism of the innominate might be successfully treated by ligature of one of the branches of that artery. His argument is as follows: Knowing from the observations of Sir Everard Home and later writers that complete arrest of the circulation was not essential to its cure, but that a very considerable reduction of the flow was sufficient, he had believed that the progress of an innominate aneurism might be arrested by simultaneous ligation of the common carotid and of the subclavian in its third portion. But afterwards, having reflected upon the means by which nature obtains a spontaneous cure, and upon the fact that some coagulum is found in every sac at the point where the circulation is least rapid, he had reached the conclusions that a reduction of the rapidity of the current was the first step in spontaneous cure, and that, as this reduction is at first necessarily slight, the process could be accurately imitated, and coagulation started by ligation of a single one of the branches of the artery, even of the third portion of the subclavian. But, as he had noticed in a case of almost complete spontaneous cure that the carotid was occluded, he thought nature should be still further imitated, and the carotid tied rather than the subclavian.

I shall not stop to point out the objections to this argument; it is sufficient to show that the case which is quoted in its support proves, if anything, the contrary. The case is the well-known one of Mrs. Denmark, aneurism of the innominate with occlusion of the carotid, for which Wardrop tied the subclavian in its third portion. Pulsation returned in the carotid on the ninth day after the operation, but the disease was apparently cured, and remained so for more than a year, the patient dying twenty-six months after the operation in consequence of its return. At the autopsy the sac was found partly consolidated, with a channel of communication between the aorta and carotid, the latter vessel being pervious throughout, and the subclavian to within a quarter of an inch from the ligature, although its lumen was contracted. Wardrop assumes that the carotid carries off half the blood passing through the innominate, and that the branches of the subclavian and its third portion each receive one-fourth. By tying the subclavian, therefore, he diminished the outlet by one-fourth, but by the reopening of the previously occluded carotid it was increased by one-half, and the consolidation, which did not take place while the flow was reduced one-half, was produced during the subsequent increase of the flow, and therefore must have been due to some other cause than reduction of the amount of blood passing through the sac.

It seems evident that the distinction which has become classical among us between "Brasdor's method" and "Wardrop's method," as we understand the terms, was not recognized by Wardrop. According to his view of it, Brasdor's method was simply that of distal ligation, and included those cases in which branches intervened between the ligature and the sac, as well as those in which they did not.

Wardrop's teachings and practice have found many imitators. It is not my purpose to trace further the history of the method, and describe the numerous operations that have been done in accordance with it. That has been done in a most complete and masterly manner by Prof. Sands, in the paper to which I have already referred. I shall restrict my examination, therefore, to cases of simultaneous ligation of the common carotid and the subclavian in its third portion for the cure of supposed aneurisms of the innominata, an operation upon which considerable experience has accumulated since Prof. Sands's paper was published. The following account of an unpublished personal case may serve as an introduction to the subject.

CASE.—Patrick I., an Irish labourer, 34 years old, sought admission to Bellevue Hospital early in January, 1880, to be treated for severe pain in the right shoulder and neck. He was assigned to a medical division, and subsequently transferred to my care in the first surgical, the diagnosis of innominate aneurism having been made by several members of the visiting medical staff. The following notes of the case were taken immediately after his transfer:—

The patient is a spare, medium-sized man, of rather dissipated habits, but with no history or sign of syphilis. Ten months before admission (March, 1879) he first felt sharp pain in his right shoulder, running up to the back of the head, and noticed at the same time a lump in his neck above the right sterno-clavicular articulation. The pain lasted about two months, and the lump, he says, diminished for a time. The pain returned in four months, and has since continued with intermissions, becoming so severe about a month before he entered the hospital that he was compelled to stop work. The lump has lately increased rapidly in size.

On examination there is found a pulsating tumour at the root of the neck, rising an inch and a half above the clavicle, and extending from a point midway between the left sterno-clavicular joint and the median line three inches to the right, apparently displacing the sternal end of the right clavicle forwards. The skin covering the tumour is normal; there is lateral expansive pulsation, and a soft bruit with distinct transmission of the heart sounds. On percussion dulness is found less than an inch below the clavicle, increasing to absolute flatness over the tumour itself. There is no bulging of the ribs. The apex beat of the heart is one and a half inch below and to the inner side of the left nipple; both carotids beat strongly; there is a good radial pulse on the left, but none on the right side; weak pulsation can be felt in the right brachial artery. Pupils equal and dilated. No change in the voice; trachea not displaced to the left. The muscles of the right scapula are notably wasted, and the right arm is smaller than the left; the forearms are of equal size, the patient is right-handed, and has not noticed any weakness in his right arm.

The diagnosis of innominate aneurism, and the proposed method of treatment, were accepted at a consultation of the surgeons, and the operation was performed January 22d, in the presence of my colleagues at the hospital.

Each artery was exposed by a straight incision and tied with carbolized catgut, the carotid above the omo-hyoid, the subclavian outside the scaleni. Both ligatures were passed before either was tied, and no change occurred in the pupils or in the tumour when the knots were drawn. Each ligature

was composed of a single strand of catgut, E violin string, No. 70, that had been kept in carbolized oil for two years; the knot was drawn with sufficient force to divide the middle coat of the artery. The operation was done antiseptically, the wounds closed with catgut sutures, a short drainage-tube inserted into each, and the whole covered with carbolized gauze, the upper edge of the dressing being fastened down by a broad overlapping band of adhesive plaster.

Pulsation was felt in the right radial artery just before the operation, and also in the subclavian after it had been exposed.

The constant movements of the patient's head disarranged the dressing, so that the carotid incision, and perhaps the subclavian also, did not remain protected antiseptically, but the patient made a prompt recovery, his temperature not rising after the second day above 99½°. Both wounds united primarily, except at the site of the drainage-tubes, and the subclavian incision was entirely healed by the 15th of February; the carotid wound was reduced by February 1st to a small, slightly oozing surface no larger than a pea, underneath which a firm mass as large as a filbert could be felt, apparently inflammatory induration between the skin and the ligature. By the 16th of February this hardness had disappeared, and the oozing surface had cicatrized.

The immediate effect of the operation was to relieve the pain in the shoulder and neck; it returned after ten days, and then disappeared permanently after the application of a blister. During the fortnight following the operation there was no change in the tumour, then the skin covering it became somewhat reddened, and the patient complained of an occasional sharp darting pain within the lump, and of a feeling as if the clavicle were being pressed forward. There was no accompanying fever, and the symptoms disappeared in a day or two. On February 25th it is noted that the lateral diameter of the tumour was only two and a half instead of three inches, and that it rose to a less height in the neck; the murmur had been barely appreciable for a fortnight, and the expansive impulse distinctly less. During the following fortnight it diminished rapidly in size, and by March 22d its lateral diameter was reduced to an inch, and its height above the clavicle to about three-fourths of an inch. It still pulsated. April 9th the tumour was barely visible, but could be felt as a hard lump behind, and rising half an inch above, the clavicle. Patient felt perfectly well, and insisted upon leaving the hospital.

In Prof. Sands's paper are to be found the details of three cases of this operation; Mr. Holmes, in his lectures upon the surgical treatment of aneurism,[1] collected three more; and to this list I have been able to add eleven, together with two in which the operation was attempted, but abandoned on account of the difficulty of exposing the vessels, and one in which there was an interval of two days between the operations upon the two arteries. The following table contains the seventeen cases first mentioned:—[2]

[1] Lancet, 1872 to 1875.

[2] The second case given in the list in Agnew's *Surgery* is incorrectly reported there. Cuvellier tied the carotid and the subclavian in its first portion, not in its third; and the disease was known at the time to be a traumatic aneurism of the third portion of the subclavian, not of the innominata. The ligature was knowingly placed on the proximal, not on the distal side. The case is reported in full in Demme's *Militär Chirurgische Studien*, 2d part, page 116.

No.	Operator, and where reported.	Date.	Sex and age.	Result.	Cause of death, and result of autopsy.	Remarks.
1	C. Heath. Lancet, Jan. 5, 1867, and July 2, 1870.	Nov. 21, 1865.	F. 30	Recovered from operation. Died Dec. 8, 1869.	Hemorrhage from sac. Sacculated aneurism springing from right side of ascending aorta, with slight dilatation of the orifice of the innominate. (Path. Soc. Trans., vol. XXI., 1876.)	Pulsation was diminished.
2	Maunder. Lancet, Sept. 28, and Oct. 12, 1867, and Maunder's Surgery of the Arteries, p. 26.	Sept. 18, 1867.	M. 37	Died on 6th day.	Death attributed to obstruction of aorta by recent clot. Small aneurism of the arch of the aorta The sac was full of recent clot, continuous with one filling the arch of the aorta between the heart and the sac.	Operation rendered very difficult by œdema and distension of veins. Patient unconscious and cyanosed for 36 hours before death.
3	Hodges. Boston Med. and Surg. Journal, Aug. 6, 1868.	Apr. 11, 1868.	M. 55	Died on 12th day.	"Apparently exhaustion." No true aneurism. Innominate dilated to about three times its natural size. Much enlargement and atheroma of aorta.	Hemorrhage on 9th day from internal jugular, requiring a ligature.
4	Sands. Med. Record, Feb. 1, 1869.	July 16, 1868.	F. 43	Recovered from operation. Died 14 months afterwards.	Progress of disease Sacculated aneurism of aorta, pressing back and taking the place of the innominate.	Relief of symptoms; apparent arrest of the disease for several months.
5	Lane. Lancet, Jan. 13, 1872, and July 20, 1872, p. 60.	Sept. 20, 1871.	F. 40	Recovered from operation. Died about three months afterwards.	Rupture of sac externally. No autopsy. Holmes (Lancet, July, 1872) thinks the aneurism was probably of the aorta.	
6	Holmes. Lancet, July 20, 1872.	Nov. 16, 1871.	M. 50	Recovered from operation. Died Jan. 10, 1872.	Progress of disease. Aneurism of innominate, opening by a very large orifice into aorta. Almost filled with coagula, which were very adherent but not regularly laminated.	Catgut ligature. Lister method tried but abandoned because the dressings shifted. Tumor diminished at first, then increased rapidly. Galvano-puncture 2 weeks before death, followed after 2 days by rapid increase, redness, and œdema.
7	Durham. Quoted by Holmes. Lancet, 1872, vol. ii. pp. 37, 69.	.....	.....	Died on 6th day.	Shock. Very large aneurism of innominate overlapping carotid.	
8	McCarthy. Maunder's Surgery of the Arteries, p. 22.	Oct. 16, 1872.	M. ..	Died on 15th day.	Hemorrhage from proximal side of the subclavian ligature.	
9	Ensor. Lancet, Feb. 6, and July 31, 1875.	Sept. 8, 1874.	M. 50	Died Nov. 12, 1874.	Hemorrhages from sac through carotid wound. Aneurism involved the whole of the innominate; semi-solid contents. Dilatation of the aorta.	The aorta was thought to be involved, and the operation was done to relieve pain. Patient, who was a Hottentot, improved for a month, then grew rapidly worse.
10	Weir. Oral communication.	June 22, 1876.	M. 45	Died on 15th day.	Rupture of aneurism into trachea. Aneurism of anterior wall of innominate, extending up in front of carotid; upper half of sac filled with laminated clot; rupture at lower edge of clot. Dilatation of aorta and of 1st inch of left carotid. Small proximal clot adjoining ligature in each vessel; branches of subclavian pervious and not enlarged.	

No.	Operator, and where reported.	Date.	Sex and age.	Result.	Cause of death, and result of autopsy.	Remarks.
11	Eliot. Am. Journ. Med. Sciences, Apr. 1877, p. 374.	Oct. 15, 1876.	M. 41	Died on 26th day.	Repeated hemorrhages from sac. Large aneurism of anterior wall of innominate. Aortic orifice of the vessel 2 inches in diameter. Sac occupied by laminated clot extending into the subclavian and carotid.	Subclavian ligature came away on 18th day; carotid ligature loose in wound at death. 3xss solution of persulphate of iron injected into sac on 17th day, after ulceration and first hemorrhage; this was followed by discharge of bloody serum for 3 days, and protrusion of a dry clot which fell out on 24th day, leaving a hole admitting three fingers.
12	King. Lancet, 1878, vol. i. p. 823.	Dec. 9, 1876.	M. 37	Recovered from operation. Died March 30, 1877.	Hemorrhages from a diverticulum of the sac which arose from its lower end and extended up in front of the carotid, communicating with an abscess which opened at the lower end of the carotid cicatrix March 27th. Aneurism occupied entire length of the innominate, and was filled by a firm clot which extended to the ligatures on the two arteries.	Catgut ligatures. Lister dressing. Tumour diminished and grew firm. Patient was fractious and left hospital Feb. 24th, returned Feb. 27th, having been drunk during all the interval, feeling miserably ill, and with redness and distension of the right carotid region which terminated in an abscess.
13	Barwell. Med. Chir. Trans., 1878, vol. lxi. p. 13.	Aug. 14, 1877.	M. 45	Recovered from operation. Died Nov. 24th, in consequence of exposure while intoxicated.	Pneumonia. Aneurism of aorta involving the anterior wall of the innominate and the origins of the right carotid and subclavian. Both arteries firmly plugged. Sac occupied by a firm laminated clot ½ inch thick at thinnest point, with a central globular cavity 1 inch in diameter.	Catgut ligatures. Lister dressing. Tumour was reduced to a small hard lump behind the clavicle and was considered cured Oct. 22d.
14	Barwell. Med. Chir. Trans., 1879, vol. lxii. p 217.	Dec. 6, 1877.	M. 48	Died in 30 hours.	Never recovered from ether, remaining cyanosed and epileptoid until death. No account of autopsy.	The specimen was exhibited, but was not described.
15	Barwell. Med. Chir. Trans., 1879, vol. lxii. p. 217.	Dec. 6, 1877.	F. 37	Cured.	.....	Catgut ligatures. Lister method. Tumour diminished, but pulsation persisted in protuberant chest wall. Left hospital Aug. 1878, married Feb. 1879.
16	Barwell. Med. Chir. Trans., 1879, vol. lxii. p. 217.	Jan. 17, 1878.	F. 27	Cured.	.....	Catgut ligatures. Lister method. In April pulsation had ceased in tumour and chest wall. Patient was exhibited to the Society Dec. 10, 1878.
17	Stimson. Case herewith reported.	Jan. 22, 1880.	M. 34	Cured (?).	.....	Catgut ligatures. Imperfect Lister dressing. 2½ months after operation tumour reduced to a small, hard lump behind the clavicle.

In connection with this list we may consider also with advantage three other cases, which, strictly speaking, do not belong in it. They are those of Broca, Hutchison, and Speir.

In 1862, M. Broca tied the subclavian in its third portion, for the cure of an innominate aneurism, the carotid being and remaining occluded by pressure. Broca speaks cautiously of the result as a *demi-guérison*. The tumour solidified and the patient died of gangrene of the lung, "in no way attributable to the aneurism, which was filled with fibrinous clot, leaving a cavity in the centre of the size of a small fowl's egg, communicating above with the subclavian and carotid, and below with the aorta."

This account was communicated by M. Broca to Mr. Heath, and reported by the latter in the *Lancet*, July 2d, 1870, in connection with his own case.

In 1867, Prof. Hutchison[1] undertook the double operation, the patient being a man 48 years of age. The carotid was exposed through a V-shaped incision and tied near its origin, the intention being to tie the subclavian in its first portion, but as this was found to be impracticable, the vessel was sought outside the scaleni, and the ligature, as was supposed, applied to it there. No pulsation could be felt at the time in it or in the arm. Death was caused by suffocation on the forty-first day, the patient having been more comfortable, and his breathing easier until a few days before his death. At the autopsy an aneurism of the arch of the aorta and innominate was found, involving the orifices of the right carotid and subclavian which were separated about an inch. The sac was nearly filled with laminated clot which extended into the carotid to the site of the ligature, and into the subclavian beyond the origin of the vertebral artery, plugging both vessels. No trace was found of the subclavian ligature, and the continuity of the vessel was uninterrupted. Dr. Hutchison thinks the ligature must have been placed upon the sheath.

In both these cases the result sought by double distal deligation was obtained; that is, circulation through the sac was diminished or arrested —and therefore they may be taken into account in estimating the effect of the operation upon the disease. For the same reason may be added the reports of three autopsies; one, quoted by Prof. Sands, was made in 1843 by Deville and Bérard upon the body of a man who had died of aneurism of the subclavian. The third portion of the artery was occluded, as were also all its branches and both carotids; yet the aneurismal sac was not obliterated. The second is one reported by R. Douglas Powell;[2] a case of aneurism of the innominate in a man of 31, not recognized during life, in which the origin of the subclavian and the entire length of the common carotid were obliterated, while the sac was empty except for a few layers of fibrin at its upper part. Death was caused by rupture of the sac. The third[3] showed occlusion of the innominate and partial occlusion of the left carotid and subclavian in a case of aneurism of the arch of the aorta without production of clot.

In Dr. Speir's[4] case the operations were so nearly simultaneous that it deserves mention in this connection. Dr. Speir occluded the carotid by means of his artery constrictor Aug. 4, 1874, and tied the subclavian two days afterward, in a

[1] Med. Record, 1867, p. 265.
[2] Virchow's Archiv., vol. 73, p. 594.
[3] Path. Soc. Trans. 1869, vol. xx.
[4] Arch. Clin. Surg. (N. Y.), Sept. 1876.

man 31 years of age, with supposed aneurism of the innominate. The patient died Sept. 7th, in consequence of repeated hemorrhages from the sac, over the apex of which the skin had sloughed. The autopsy showed a pouched aneurism of the summit of the arch of the aorta, the orifice of which was a semi-lunar rent 1¼ inches long. The innominate and its branches were healthy. The sac was filled with coagulum projecting through the orifice. The coagulation seems to have been due to inflammation of the sac.

Finally, the operation has been attempted and abandoned in two cases, once by Dr. Cheever, of Boston, and once by Mr. Christopher Heath, of London.

Dr. Cheever[1] operated upon a man 38 years of age. Etherization was accomplished with much difficulty, on account of dyspnœa produced by the recumbent position, and anæsthesia was not obtained until after the lapse of twenty minutes and the use of eight ounces of ether. The patient then being livid, the ether was withdrawn and the operation begun. An attempt to tie the carotid having failed in consequence of profuse venous bleeding which made it impossible to find the vessel, the subclavian was next sought. This artery could not be seen, but it was felt and held under the finger while the needle was passed; as the point of the instrument emerged from beneath the vessel a smart gush of venous blood filled the wound, causing the patient to gasp and the pulse to disappear. In the effort to secure the subclavian vein, which was supposed to have been wounded, the incision was enlarged and the central portion of the clavicle removed, but the patient appearing to be moribund, his face blue, and his blood the colour of prune juice, the operation was abandoned. The patient died two hours afterwards. The aneurism was of the innominate, as large as an orange, and coated with a layer of firm fibrin. The vertebral artery was plugged.

In Mr. Heath's case[2] the patient was a man 45 years of age. He began the operation with the subclavian, encountering much bleeding and great difficulty in the search. At last he came upon a pulsating sac which appeared to be the aneurism extending further than was anticipated. So, considering the application of a ligature impossible, he plugged the wound with lint and tincture of iron. Bleeding recurred at intervals, and the patient died on the 6th day.

The autopsy showed a sacculated aneurism springing from the arch of the aorta in front of the innominate. The sac reached into the outer triangle of the neck, where it was seen during the operation, and where it ultimately gave way.

Of these twenty-two cases we may almost say what Mr. Holmes has said of the Hunterian operation upon the innominate and first portion of the subclavian, that they are a ghastly record of death and blood; but they present a measure of success, one that is not inferior to that of any other known method of treatment of this most formidable disease. There is, however, less to be gained by treating them as statistics and establishing percentages of success and failure, than by seeking what light they may throw upon the method and possibilities of cure.

The possibility of the cure, of the obliteration of the cavity, of an aneurism by complete distal occlusion has been demonstrated by operation and by spontaneous cure following impaction of a clot. Mr. Holmes claimed in 1872 that the same possibility existed in innominate aneurism, and he presented facts to "afford definite proof of the curative power of distal obliteration of the arteries in innominate aneurism." Of the six facts which he presents only two have any claim to be considered proofs, and even they are

[1] Boston Med. and Surg. Journal, May 6, 1869.

[2] Path. Soc. Trans., vol. xxii. p. 95.

not beyond reproach, because, although in each case the sac was filled with firm coagulum, there was still a small channel through which blood passed to the subclavian. One of these was a case of spontaneous cure by impaction; the other was the case in which Wright, of Montreal, tied the carotid. In the third case the left carotid was tied for aneurism of that vessel extending into the aorta; the upper portion of the sac became filled with clot, but rupture took place below into the lung. In each of the remaining three cases the subclavian was found occluded after death, and Mr. Holmes thinks that if the carotid had been tied a cure would have been effected. The list of such cases might be materially increased, but they are not "proofs." On the other hand, the specimens of Deville and Bérard, and of Mr. Powell, above referred to, show that total distal occlusion does not always produce consolidation.

So far as I know there are but two specimens that prove the possibility of such a cure. They are the ones furnished by Cases XII. and XIII. of this table, and even in one of these the permanency of the cure was destroyed by the formation of a second aneurism at the proximal border of the first. In addition we have Broca's case, a "half-cure" prevented perhaps from becoming a complete one by a fatal intercurrent disease, and, if clinical evidence may be accepted, Barwell's last two cases. (Cases XV. and XVI.)

The same specimens and cases show the possibility of a cure by a distal occlusion which is not complete, but only partial. They are all cases of occlusion of the carotid and of the subclavian in its third portion, and all, with the exception of Broca's, cases of double simultaneous ligation. There is also another case[1] which bears upon this point, although the aneurism was of the first part of the subclavian, not of the innominate.

The patient was a man forty-six years of age who fell while carrying a heavy load upon his right shoulder. The next morning he noticed a marked change in his voice, and soon afterwards a pulsating tumour appeared just above the right side of the sternum. Severe pain in the shoulder and neck caused him to seek admission to St. Luke's Hospital nine months after the fall. A pulsating tumour giving no murmur was found above the inner end of the right clavicle, measuring one and a half inches in lateral diameter, and extending one inch up the neck. Voice husky; right vocal cord paralyzed. The diagnosis of aneurism of the first portion of the subclavian was made, and Dr. J. L. Little tied the carotid and the subclavian in its third portion May 4, 1877. The tumour presented but little if any change during the following three months, and then diminished perceptibly during the fourth month after an attack of left hemiplegia and aphasia, which occurred July 23. The patient recovered partially from the paralysis, the left arm remaining somewhat rigid, and a year after the operation the tumour had almost entirely disappeared. He is still living, and there has been no recurrence of the disease.

[1] Arch. Clin. Surg. (N. Y.), Oct. 15, 1878, p. 13.

It is especially worthy of remark that the two specimens (Cases XII. and XIII.) show that the partial arrest had become complete by the plugging of the entire length of the subclavian, and it seems not unlikely that the cure was effected first by the production of a clot in the sac in consequence of the slowing of the current, and secondly by the growth and extension of the clot into the subclavian. In no case, at least, do we find such plugging of the subclavian when the sac is not filled with clot, or when the aneurism has proved to be of the aorta; such cases present no exception to the rule that a clot does not extend backward beyond the branch nearest the ligature.

These two specimens and the other successful cases, including Dr. Little's, weaken the force of the objection often made to ligature of the subclavian in its third portion, that communication between the branches of that vessel and the sac is sufficient to defeat the object of the ligature.[1] They show that a cure can be accomplished notwithstanding it, but, on the other hand, it must be remembered that there are other cases to show that this complete occlusion does not necessarily follow, even after partial consolidation of the sac; just as obliteration of the sac may fail after complete distal occlusion.[2]

It is evident that factors other than mere arrest or retardation of the current are concerned in the production of a cure. One of these is the varying coagulability of the blood, and another may perhaps appear on examination of the conditions disclosed by the autopsies quoted above.

It is very well known that the tendency of blood to coagulate within the vessels varies under conditions, the influence of which is not entirely understood. It might be sufficient to refer in illustration of this fact to the spontaneous coagulation which takes place in some pouched sacs, and to the uninterrupted progress of the disease and entire absence of coagulation in others, or to the benefit sometimes obtained by absolute rest in the recumbent position; but there are other illustrations much more strik-

[1] Prof. Sands says: "It is not difficult to explain the failure of the various operations detailed. In all of them the branches of the subclavian . . . are left open, and the current of blood passes into them through the aneurism with sufficient force to prevent the deposition of laminated fibrin. . . . In no case does the cavity of the aneurism seem to have been obliterated." And Mr. Holmes says: "The ligature of the third part of the subclavian necessitates the continuance of circulation through the sac; and if so, the absolute obliteration of the tumour, its radical cure in the strictest sense of the term, making relapse impossible, cannot be obtained by this means."

[2] I have met also with one case of so-called spontaneous cure of an aneurism of the innominate, the vessels remaining pervious. It is reported in the *Path. Soc. Trans.*, 1873, vol. xxiv. p. 39, as a "solidified aneurism of the arch of the aorta and the innominata as large as a large lemon, with a direct channel of communication through it to the subclavian and probably also to the carotid. The coagulum was uniform in colour and texture, organized and laminated, and in no part was it soft or looking as though it was degenerating or breaking down."

ing. The simple introduction of a hypodermic needle into a femoral aneurism and its retention there for an hour or two was sufficient in one case to start a consolidation that became complete, and in another case the similar introduction of six needles and their retention for four days produced the same result; while in a personal case the introduction of a loose bundle of horsehair, consisting of about fifteen pieces each six inches long, into an ilio-femoral aneurism, produced not the slightest change in the physical symptoms of the tumour during the month that elapsed before I finally tied the external iliac and cured the disease. Even the clot formed in a vessel on the proximal side of a ligature varies greatly in size, or may be entirely absent. After ligature of the carotid near its bifurcation the clot is frequently found to extend from the ligature to the origin of the artery, but in Case VI. there was practically no clot at all in either vessel. Such varying results, due to unknown and uncontrollable causes, might determine the success or failure of an operation.

Another element, important, I think, in determining the result, is the character and especially the size of the communication between the aneurism and the aorta. The twenty-two cases contained in this paper furnish eight autopsies bearing upon this point, Cases VI., IX., X., XI., XII., XIII., Broca's, and Hutchison's. In three of these (XII., XIII., and Broca's), the sac was filled with a firm coagulum entirely in one case, and with the exception of a central globular cavity in the two others. In two of these three the proximal orifice of the innominate was apparently of normal size; in the remaining one it was involved in the dilatation which included the adjoining portion of the aorta. In Case X. the orifice of the innominate was somewhat enlarged; as death was caused by rupture of the sac a fortnight after the operation, it was impossible to say what the ultimate effect might have been had life been prolonged. The specimen, which is preserved in the Roosevelt Hospital Museum, is suggestive of a possible cure.

In Cases VI., IX., XI., and Dr. Hutchison's, the orifice was very large, and in two of them formed part of a general dilatation of the arch of the aorta. They all contained some clot, but in all death was caused by the progress of the disease after the lapse of a period of time sufficiently long to have given the treatment a reasonable opportunity to effect a cure if it was possible.

The most, perhaps, that can be claimed for these facts, limited as they are in number, and incomplete in detail, is, that they do not conflict with the general impression that a narrow orifice favors consolidation. But when the aneurismal expansion includes not only the proximal orifice of the innominate but also the adjoining portion of the aorta, there is but little hope of obtaining a permanent cure by the operation. Laminated fibrin may indeed be deposited in the upper portion of the sac, and the advance of the disease may be arrested at that point, but the weakened wall of the

aorta is not relieved from the strain, and the disease may progress there unchecked. The relief afforded, and the arrest of growth obtained recently in cases of aortic aneurism by ligature of the left carotid, may indeed inspire a hope of similar gain in cases such as we are considering, and this possibility must be taken into account in weighing the chances of an operation, but the gain, great as it may be, is far from being a cure of the disease.

I do not know if there are any preparations in existence showing the condition of the aneurismal wall and the nature of its connection with the inclosed fibrin after complete consolidation and cure. Pathologists have described the mode in which an aneurism enlarges, but are silent concerning the details of its contraction. We know that the tumour continues to diminish long after all pulsation has ceased in it, and that this reduction may be so extreme as to leave nothing but a barely recognizable nodule. Such a change is not compatible with the presence in the sac of the fibrin originally deposited there; it must disappear to make contraction possible. This disappearance is possible only through regressive changes in the fibrin, by its liquefaction and escape into the adjoining artery, or its absorption by invading tissue. Organization of a clot, in the sense of its direct transformation into living tissue by the ulterior development of the cellular elements of the blood deposited in it simultaneously with, or subsequently to, its coagulation, is an untenable, I may say an exploded, theory. Microscopical examination of a thrombus shows two sets of changes, one in the clot, the other in the vessel-wall. The fibrin softens, the vessel-wall proliferates, and the granulations springing from the latter penetrate into the clot or spread over its surface. It is to this growth that the attachment of the clot to the vessel is in great part due, for the granulations send out long interlacing processes into the interior of the clot, which bind the two surfaces together.

If now we apply to the aneurism the knowledge gained by a study of the thrombus, we have a possible explanation not only of its contraction, but also of the danger of a large proximal orifice. In a half-consolidated aneurism we find a clot that is closely adherent at the point were it presumably began to form, and loose at others, especially at its edge, where the clot has either grown rapidly or has been kept apart from the wall by an interposed layer of blood, so that the granulations have not had time to form or an opportunity to penetrate it. The blood, entering with full force through the large orifice, makes its way between the clot and the wall, and exerts upon the latter the same pressure that it would exert were no clot present, and thus the main condition necessary to the expansion of the sac, direct pressure of the blood upon it, is maintained. The very enlargement of the orifice of the innominate is in itself an evidence of weakness at that point, and adds force to an objection raised by Prof. Sands against the distal ligature, an objection based upon the usually

unhealthy condition of the vessel-wall on the cardiac side of an aneurism. Case XII. furnishes corroborative evidence.

Both these conditions, the degree of coagulability of the blood and the size of the orifice, so potent in their influence upon the results of the treatment, are beyond our power to recognize beforehand, and they add another to the uncertainties of the diagnosis, already so great.

The term "supposed aneurism of the innominate," so frequently employed in the discussion of this subject, and in the record of cases, is a recognition only too well justified of the difficulties attending the diagnosis. The cases mentioned in this paper, together with three others[1] encountered incidentally in the search, in which some method of treatment other than the one now under consideration was adopted, furnish nineteen autopsies. In seven of these the aneurism was found to be purely aortic, in four it involved both the aorta and the innominate, in two there was dilatation of the aorta or of the aorta and innominate, but no true aneurism, and in only six was the innominate alone involved. When it is remembered that most if not all of these were hospital cases, and that the aid of others in the diagnosis was sought by the surgeon in charge, notably in some of the cases where the error was greatest, it is evident that the mistakes were the result not of ignorance or lack of care, but of the insufficiency of the diagnostic means at our disposal. And when it is further noticed that an aneurism of the aorta may extend up into the neck, overlapping and taking the place of the innominate, and even pass out between the scaleni, we are at a loss to understand how a correct and positive diagnosis can be made.

Such being the facts, what opinion should be held concerning the advisability of the operation? The answer to that question requires consideration not only of the percentage of success, but also of the possible amelioration of symptoms, of the value of alternative measures, and of the risk inherent in the operation itself. Two, three, or even four successes in a total of twenty-two cases is not a proportion to give much encouragement, but can

[1] Two of these are included because the subclavian and carotid were tied, and the third, because it is contained in previous tables, although in it the carotid alone was tied. The cases are: (I.) One in which Hobart tied the carotid and first part of the subclavian in 1839. The patient died of secondary hemorrhage from the carotid ligature. The autopsy showed a pyriform aneurism of the aorta overlapping the innominate. The case is quoted by Mr. Holmes in the *Lancet*, July, 1872. (II.) One in which Mr. Knowles tied the right common carotid "for supposed aneurism of the lower portion of its trunk involving perhaps the innominate." The patient died three months afterwards of apoplexy, and the autopsy showed an aneurism of the aorta. (*Lancet*, 1868, vol. i. p. 750.) (III.) An unpublished case in this city. The common carotid was tied, and two or three years afterwards the subclavian, in its third portion, for supposed aneurism of the innominate. The patient survived the last operation about three years, dying in Bellevue Hospital in 1879 of phthisis. The specimen is preserved in the museum, but has been prepared by plaster injection to show only the collateral circulation. As well as can be made out in its present condition, there is no aneurism of the innominate, and only a uniform dilatation of the first six or eight inches of the aorta. The branches of the subclavian are pervious, and the supra-scapular is considerably enlarged.

a better one be secured by other means? The only other operations that can be proposed are the ligature of only one artery instead of both, or the application of the ligature to the subclavian in its first instead of in its third portion. Of the first, Prof. Sands records nineteen cases with only one recovery, and on theoretical grounds there is every reason to maintain that if anything can be gained by tying one vessel, more will be gained by tying two, and the risks of the operation are not materially increased thereby. The second (ligature of the carotid and of the subclavian in its first portion) has been done twice, the cases terminating fatally in six and fourteen days respectively. It is probable that with the aid of antiseptics a catgut ligature could be placed upon the first portion of the subclavian without much danger of secondary hemorrhage, but the presence of an aneurism would almost inevitably make it impossible to expose the vessel.

Compression by means of temporary ligatures, silver wire, or specially devised instruments may be passed by without remark, since the principle is the same as that of distal ligation, and the risks of the operation little, if at all, less. Galvano-puncture is more dangerous than ligation, and the temporary introduction of needles has yet to be tested.

The only remaining alternative is the treatment by rest and restricted diet. All recent authors recommend in a rather perfunctory manner that this should be tried before resort is had to operative procedures; and in many of the above-mentioned cases it is recorded that this advice was followed without any apparent good result. The method is one that requires much fortitude and self-control on the part of the patient, while most of the cases come from a class who are but little accustomed to exercise any restraint upon their appetites, their passions, or their feelings. Even when aided by the moral effect of an operation and the physical weakness following it, it is often difficult to restrain them. In Hobart's case secondary hemorrhage was brought on by the patient springing from her bed in a fit of temper and throwing a pillow at the nurse. In cases V., XII., and XIII. death was hastened, if not directly caused, by the refusal of the patients to remain in hospital, and by their indulgence in liquor, notwithstanding their knowledge of the danger incurred by this conduct. In my own case the patient was a sullen, vindictive man, intolerant of pain, and impatient of control. The slightest or most quickly remedied neglect would excite in him a feeling of anger that would manifest itself for days whenever the offender came near him. An attempt to restrict his diet before the operation almost led to his leaving the hospital, and it was not until after the improvement in his condition had become manifest to himself that he was willing to remain quietly in bed. What could be expected in such cases from the treatment by rest and diet?

Although the operation has effected a cure in only two cases, XV. and XVI., or in four including cases XIII. and XVII., it has often been followed by a more or less marked amelioration of the distressing symptoms, a result which is a legitimate object of treatment when a radical

cure is not possible, and when the means of obtaining it are not in themselves too dangerous. On the other hand, the operation hastened or caused death in five of the seventeen completed cases, and in both those in which the operation was abandoned after it had been begun; once, Case VIII., by hemorrhage on the fifteenth day from the seat of the subclavian ligature; twice (Case III. and Dr. Cheever's) by hemorrhage from the internal jugular or subclavian vein wounded during the operation; once, Case VII., by shock; once, Case II., on the sixth day by an unknown cause, possibly the progress of the disease, as the patient's condition was apparently desperate at the time of the operation; once, Mr. Heath's second case, by hemorrhage from the sac, which was exposed and weakened during the unsuccessful attempt to apply the ligature; and once, Case XIV., in thirty hours, by the persistence of an epileptoid condition attributed to the ether.

These facts speak for themselves, and the surgeon who refers to them will be guided by the values which he attaches to them, and the inferences he draws from them. The following conclusions are offered as a summary of a few of the points:—

I. A positive diagnosis of the origin and extent of an aneurism which has appeared behind the right sterno-clavicular articulation, and extended thence into the neck, is often impossible.

II. Simultaneous ligation of the carotid and of the subclavian in its third portion in cases of aneurism of the innominate, has been followed by complete obliteration of the cavity of the sac and of the entire length of the subclavian on the proximal side of the ligature; and in other cases, where the branches of the subclavian have remained pervious, consolidation has been so extensive as to leave only a small central channel, and the progress of the disease has been indefinitely arrested.

III. Therefore, the impossibility of safely placing a ligature upon the first portion of the subclavian is not a weighty argument against the treatment of innominate aneurism by distal deligation.

IV. Cases IV. and XIII., and the successes obtained by Mr. Holmes and Mr. Heath in the treatment of aortic aneurism by ligation of the left common carotid, diminish the objections arising out of the difficulty of making a diagnosis.

V. The operation deserves a position among surgical procedures of recognized gravity, but admitted propriety.

VI. Consolidation follows so slowly after the operation that the latter can do no good when the sac is inflamed or rupture is threatening.

VII. If the operation is undertaken when the aneurism is large and the breathing obstructed, no anæsthetic should be used.

NOTE.—*May* 20. Patient presented himself for examination. He was under the influence of liquor, and confessed to steady drinking since he left the hospital a month ago. The pulsating tumour, somewhat reduced in size since the last examination, could still be readily felt behind the clavicle. He complained of nothing except that his right hand was cold in the morning.

ARTICLE III.

IS THE ACTION OF THE MEDULLA OBLONGATA IN NORMAL RESPIRATION REFLEX? By AUSTIN FLINT, Jr., M.D., Professor of Physiology and Physiological Anatomy in the Bellevue Hospital Medical College, New York, etc.

IN connection with a series of experiments published in 1877, the question occurred to my mind whether or not the action of the medulla oblongata in normal respiration could strictly be classed among those operations recognized by physiologists as reflex. That the medulla oblongata is the centre presiding over certain reflex phenomena, acting through some special nerves, there can be no doubt. This centre seems to serve as a co-ordinator of the muscles of expression, and it has certain reflex functions connected with the respiratory muscles, such as coughing, sneezing, etc. In certain instances, also, in which respiration is temporarily suspended, a stimulation of parts of the general surface, as by a dash of cold water, will excite respiratory movements. Such an action as the one last mentioned might properly be called reflex; but the phenomena which I here propose to consider are those of ordinary, normal respiration and the exaggerations of the respiratory sense which amount to a more or less intense feeling of want of air.

The general view under which physiologists have been accustomed to regard the respiratory movements as reflex is the following: It has been thought that there existed in some part of the organism or in the system at large a certain sense, which may be called the sense of want of air, the respiratory sense, or the *besoin de respirer* of the French, dependent upon either an actual or an impending deficiency of oxygen or upon an impression produced by the circulation of blood containing carbonic acid in parts that should normally receive oxygenated blood. This "respiratory sense" has been taken as the starting-point of the respiratory acts. Regarding a reflex phenomenon as involving an impression conveyed by afferent nerves to a nerve-centre, which impression, by the action of the nerve-centre, is converted into a stimulus and is reflected along certain efferent nerves to muscles, the conditions of the operation of reflex action in ordinary respiration have been regarded as complete. The respiratory sense, according to this view, is conveyed by certain centripetal nerves to the medulla oblongata, and here it is converted into a stimulus which is conveyed by the proper centrifugal nerves to the respiratory muscles, and there follows an act of inspiration.

My principal object, in this article, is to discuss the question of the so-called reflex action of the medulla oblongata in respiration, drawing my conclusions mainly from my own experiments. I shall not, therefore, attempt to give a full account of the literature bearing upon the action of

the medulla oblongata as the respiratory nervous centre, or even of the experiments which relate to its reflex function, except in so far as the latter have been followed by important advances or changes in the views of physiologists or as their history involves questions of priority.

In 1809, Legallois made a number of experiments upon rabbits, in which he showed that respiration ceased suddenly when a section of the medulla oblongata was made to include the origin of the eighth pair of nerves; but that the respiratory acts continued when the cerebrum, cerebellum, and a part of the medulla oblongata were removed by successive slices from before backward.[1] Flourens extended the observations of Legallois, and fixed the limits of the respiratory nerve-centre in the rabbit between the upper border of the origin of the pneumogastric nerves and a line drawn about a quarter of an inch below the lowest point of origin of these nerves.[2] Longet and Flourens, in later observations, restricted the limit still farther, and showed that it was confined to the gray matter of the lateral tracts, or the intermediary fasciculi.[3] Since the publication of the experiments of Flourens, nearly all physiologists have agreed that the respiratory nervous centre is situated in some part of the gray matter of the medulla, and this view I accept without reserve. Its most notable opponent, however, is Dr. Brown-Séquard. This author contends that the arrest of respiratory movements which follows destruction of the medulla is due to irritation of surrounding parts, and not to the destruction of the so-called respiratory centre; and that, in certain cases, the movements may become reëstablished after the irritation has subsided.[4] In the absence of their full confirmation by other observers, I do not regard the experiments or the conclusions of Dr. Brown-Séquard as satisfactory; and I still hold that the medulla oblongata is the centre presiding over the respiratory acts.

Marshall Hall, in his memoir on the "Reflex Function of the Medulla Oblongata and Medulla Spinalis," published in 1833, says nothing with regard to the reflex character of respiration. In the Croonian Lectures, delivered before the Royal College of Physicians in 1850, he advances the view that the normal respiratory acts are reflex and dependent upon excitation of the pneumogastric nerves by the accumulation of carbonic acid evolved in the lungs by the venous blood.[5] Subsequent observations,

[1] Legallois, Expériences sur le principe de la vie. Œuvres, Paris, 1824, tome i. p. 64. The date of these experiments is given by Legallois on page 71 of the above-mentioned work.

[2] Flourens, Système nerveux, Paris, 1842, p. 204.

[3] Longet, Traité de physiologie, Paris, 1869, tome iii. pp. 387, 388.

[4] Brown-Séquard, Recherches sur les causes de mort après l'ablation de la partie de la moelle allongée qui a été nommée point vital. Journal de la physiologie, Paris, 1858, tome i. p. 217 et seq.; and Recherches expérimentale sur la physiologie de la moelle allongée. Ibid., 1860, tome iii. p. 151 et seq.

[5] Marshall Hall, Synopsis of the Diastaltic Nervous System, London (no date), p. 43.

however, have shown that the theory proposed by Marshall Hall is incorrect; and, at the present day, it is not adopted by any physiologist of recognized authority. As early as 1839, John Reid suggested that the sense of want of air was due in a measure to the circulation of venous blood in the medulla oblongata.[1] This fact is interesting in view of the results of recent experiments which will be detailed farther on. In 1841, Volkmann made a number of experiments, the conclusion drawn from which was that the sense of want of air depends upon a certain condition of the general system as well as an impression made upon the pulmonary mucous membrane.

"The respiratory movements appear really to be of a reflex character in the following way: The exciting agent is carbonic acid—not that which has become free in the air-passages, but that which is contained in the blood; the situation of the stimulation is in every part of the body, not alone the pulmonary mucous membrane; finally, the nerves brought into action are all nerves which conduct centripetally operating toward the medulla oblongata, not exclusively the vagus."[2]

Volkmann states, immediately following the passage just quoted, that the respiratory movements find their impulse in a "respiratory necessity," and that this originates in the entire system; that all animals require oxygen from the blood in place of the carbonic acid which they give up to the blood; and that, as soon as the blood is overcharged with carbonic acid, this "necessity" (respiratory) cannot be satisfied.

In 1861 I made a series of experiments with the view of ascertaining the situation of the respiratory sense, adopting the view, which was then almost universally received, that the respiratory acts are reflex.[3] The main points in these experiments were the following:—

When the chest was opened in a living dog, and a bellows fixed in the trachea, so long as artificial respiration was efficiently performed, the animal made no respiratory efforts. In these experiments the animals were usually etherized; but in several instances they were allowed to come from under the influence of the anæsthetic. The diaphragm and other important respiratory muscles were denuded and fully exposed to view. This was almost an exact repetition of an experiment performed by Robert Hook in 1664.

An artery was then opened and the blood was allowed to flow in a small stream. When the artificial respiration was suspended, the animal began to make respiratory efforts as soon as the blood became dark in the

[1] Reid, An Experimental Investigation into the Functions of the Eighth Pair of Nerves, etc., Part Second. Anatomical and Physiological Researches, Edinburgh, 1848, p. 285; and Edinburgh Medical and Surgical Journal, April, 1839.

[2] Volkmann, Ueber die Bewegungen des Athems und Schluckens, etc. Archiv für Anatomie, Physiologie, und wissenschaftliche Medecin, Berlin, 1841, S. 342.

[3] Flint, Jr., Experimental Researches on Points connected with the Action of the Heart and with Respiration. American Journal of the Medical Sciences, Philada., October, 1861, p. 372 et seq.

arteries; but, when artificial respiration was resumed, as soon as the blood became again bright red in the arteries, the respiratory efforts ceased.

In order to ascertain whether the sense of want of air were due to a deficiency of oxygen or to the presence of carbonic acid in the blood of the arteries, I drained the animals of blood, sometimes from a large artery and sometimes by excising the heart, at the same time keeping up artificial respiration carefully and efficiently. As the system became drained of blood, there always occurred vigorous and even violent respiratory efforts, although the lungs were kept supplied with pure air.

From these experiments I reasoned that, the respiratory movements being, as I thought, reflex, the sense of want of air depended upon a deficiency of oxygen in the system at large, and not upon the presence of carbonic acid in the blood of the arteries, for the sense seemed to be felt by the animals in my experiments when the system was drained of blood, the arteries containing no blood charged with carbonic acid.

In 1868, about seven years after the publication of my experiments in the *American Journal of the Medical Sciences*, Pflüger published a very interesting article upon the same subject.[1] In this article, a very elaborate review is given of the literature of the subject. He first refers to the opinions of various authors with regard to the question of a difference in colour between the blood of the umbilical arteries and the umbilical vein, and then goes on to state that "it is established without doubt that, after birth, there is a diminution in the quantity of oxygen in the body of the newly born, which, as the following researches will show, is the real cause of respiration." The experiments by means of which Pflüger came to the conclusion that the sense of want of air, dyspnœa, and apnœa were due to a want of oxygen in the system, consisted mainly in causing animals to breathe an irrespirable gas, such as pure nitrogen.[2]

"Using blood-letting for ascertaining the condition of the blood during dyspnœa, I arrived at the following facts: As soon as the dog begins to breathe pure nitrogen, it is scarcely fifteen seconds before he makes violent and deep inspirations; at the end of thirty seconds, the most intense dyspnœa is observed, the blood is already almost absolutely black, which must be due to the enormously rapid tissue-metamorphosis of the animal. At the end of one minute the animal

[1] Pflüger, Ueber die Ursache der Athembewegungen, sowie der Dyspnoë und Apnoë. Archiv für die gesammte Physiologie, Berne, 1868, Bd. i., S. 61 et seq.

[2] Rosenthal, in his work on the "Respiratory Movements," published in 1862, anticipated the experiments of Pflüger upon the influence of the insufflation of irrespirable gases upon the respiratory movements. He noted that the manifestations of dyspnœa ceased in animals when the chest had been opened and oxygen was passed through the lungs, but that they continued when, instead of oxygen, nitrogen or hydrogen was used, "although in this case the carbonic acid, as well as the oxygen, was removed from the blood." From this it appears to follow that it is not the increased quantity of carbonic acid, but the diminished quantity of oxygen which, in dyspnœa, produces the mediate or the immediate stimulation of the respiratory central organ. (Rosenthal, Die Athembewegungen, etc., Berlin, 1862, S. 4.) My own experiments were published in 1861.

is already almost asphyxiated. The respiratory movements are very infrequent or have ceased, but the heart still beats."[1]

Then follows a series of examinations of the blood under normal conditions at various times after causing an animal to breathe pure nitrogen. In one of these observations, after causing a dog to breathe nitrogen for one minute, the oxygen of the blood was found to be reduced from 14.35 per cent. to 0.2 per cent., and the carbonic acid from 36.9 per cent. to 29.9 per cent., showing a great diminution in oxygen and a considerable diminution in carbonic acid. "No one, therefore, can be of the opinion that dyspnœa and asphyxia in breathing indifferent gases is connected with the accumulation of carbonic acid."[2]

While Pflüger assumed to give a review of the literature of the subject under investigation, he made no mention of my experiments published in 1861, although the results were nearly identical with his own. Later observations and experiments, however, have convinced me that the interpretations of my earlier experiments, as well as of those made by Pflüger, were incorrect. I do not now believe that the acts of respiration are purely reflex in the sense in which this term is generally used; and I do not believe that the sense of want of air is due to a deficiency of oxygen in the system at large. I have become convinced, by experiments made in 1877, that the real cause of the sense of want of air, with its various exaggerations and modifications, is a deficiency in, or an absence of oxygenated blood in the vessels of the medulla oblongata. This opinion has been entertained by certain physiologists on theoretical grounds, but, so far as I know, it had not been sustained by direct experiment prior to 1877.

In 1877, I made a series of experiments which seemed to me to demonstrate conclusively that the sense of want of air is due to a deficiency of oxygen-carrying blood in the medulla oblongata. The details of these experiments have already been published,[3] and I shall here give merely a summary of the results.

If the chest of a dog be opened, the animal being under the influence of ether, and if artificial respiration be efficiently maintained by means of a bellows fixed in the trachea, the animal will make no respiratory efforts so long as fresh air in sufficient quantity is supplied to the lungs. This is an old experiment, dating from the time of Robert Hook, in 1664, and has been repeatedly verified.

If, air still being supplied in adequate quantity to the lungs, the aorta be tied or the system be drained of blood, the animal will make violent respiratory efforts under the influence of the sense of want of air. This

[1] Pflüger, op. cit., S. 89.

[2] Pflüger, op. cit., S. 95.

[3] Flint, Jr., Experiments on the Effects upon Respiration of cutting off the Supply of Blood from the Brain and the Medulla Oblongata. New York Medical Journal, November, 1877, vol. xxvi. p. 449.

is due to the fact that the oxygen cannot get to the system or to some part or parts of the system, and this demonstration was made and published by me as early as 1861. Similar results were obtained by Rosenthal, in 1862, and by Pflüger in 1868.

In 1877, it occurred to my mind that it was possible to ascertain by experiment whether the sense of want of air were due to a want of oxygen in the general system or in some restricted part. It being so well established that the medulla oblongata is the respiratory nervous centre, I was naturally led to look for some means of cutting off the supply of blood from this part. This can be easily done by tying the innominate artery and the left subclavian artery in a dog, in this animal the aorta giving off from the arch these two vessels which are the only sources of supply of blood to the head and the anterior extremities. The following experiment, which I copy from my article published in 1877, shows the effect of constricting the vessels given off from the arch of the aorta. This experiment is a type of many others made in my laboratory and in public demonstrations.

September 30, 1877.—A medium-sized, full-grown dog was brought completely under the influence of ether. The trachea was then opened and connected with a bellows, and artificial respiration was maintained. Over the valve of the bellows was placed a sponge, which was saturated with ether from time to time, so that the animal was kept completely anæsthetized during the experiment. The air in the bellows was also changed from time to time by pushing up the valve with the fingers and forcing out the vitiated air. The chest and abdomen were then laid open by a continuous incision in the median line, and the ribs were bent backward and secured with a strong cord tied behind the back, so that the lungs and heart were fully exposed. The pericardium was then cut away, the great vessels near the heart were isolated, and loose ligatures were thrown around the trunk of the innominate artery, the left subclavian artery, the descending vena cava, the descending portion of the aorta, and the ascending vena cava.[1] In this way, I was prepared to constrict the several vessels at will.

When these preliminary steps had been completed, the animal being entirely under the influence of ether and artificial respiration being kept up efficiently, there were absolutely no respiratory efforts, and the diaphragm, which was exposed, was quiescent.

The artificial respiration was then arrested. In forty-five seconds, the animal began to make violent respiratory efforts. Artificial respiration was then resumed, and the respiratory efforts of the animal ceased. When the artificial respiration was arrested, we first noticed a movement of the corners of the mouth at regular intervals, and then the mouth was widely opened and the diaphragm became strongly contracted, also at regular intervals. The time was taken at the first violent respiratory effort.

The animal being perfectly quiet and making no efforts at respiration, the innominate artery, the left subclavian artery, and the descending vena cava, were tied nearly simultaneously, artificial respiration being constantly and efficiently maintained. In two minutes and eight seconds, the animal began to make respiratory efforts, which continued so long as the vessels remained constricted.

The ligatures surrounding the vessels mentioned above were loosened five

[1] In the dog, the aorta gives off the innominate artery, "which gives off first the left carotid, and then divides into the right subclavian and right carotid" (Foster, "Elementary Practical Physiology," London, 1876, p. 13). The left subclavian artery arises directly from the aorta.

minutes and twenty-two seconds after they had been tied, and the respiratory efforts of the animal instantly ceased. After three minutes, artificial respiration was stopped, and the animal began to make respiratory efforts in thirty-nine and a half seconds, which ceased as soon as artificial respiration was resumed.

The descending aorta and the ascending vena cava in the chest were then tied simultaneously, the vessels arising from the arch of the aorta being free. This seemed to produce no effect, and no respiratory efforts were made by the animal for five minutes. The innominate artery and the left subclavian artery were then constricted, the aorta and ascending vena cava remaining tied. Respiratory efforts by the animal began in one minute and twenty-six seconds, although artificial respiration was maintained. These efforts ceased when the ligatures around the innominate and subclavian were loosened.

The ligatures were then removed from the descending aorta and ascending vena cava, and the innominate and left subclavian arteries were constricted, which was followed by respiratory efforts after one minute and six seconds. These efforts ceased when the vessels were freed.

The innominate artery alone was then constricted, but this seemed to produce no effect, no respiratory efforts being made by the animal for five minutes. At the end of five minutes, the left subclavian artery was constricted, the constriction of the innominate artery being maintained. The animal began to make respiratory efforts fifty-three seconds after constriction of the subclavian. These efforts ceased on loosening the ligatures.

Artificial respiration was then stopped, and the animal began to make respiratory efforts in ten seconds. The medulla oblongata was then broken up, and the experiment was concluded.

In this experiment I had the aid of my able assistant Dr. C. F. Roberts, and Mr. Gaspar Griswold, an advanced laboratory student. As the experiment progressed, it was ascertained that the vessels could be effectually constricted by making traction on the ligatures without tying. The constriction could then be instantly removed. It was also ascertained that constriction of the veins made no difference in the phenomena observed.

The general result of all my experiments made on the plan of the one just detailed was that invariably, when the innominate and the left subclavian artery were tied, the dogs began to make respiratory efforts in a little more than two minutes after the ligation, but the animals remained quiet after ligation of the aorta in the chest. The respiratory efforts continued so long as the vessels going off from the arch of the aorta remained constricted, and they ceased almost immediately when the ligatures were loosened. During all of my observations upon the effects of tying the various bloodvessels, artificial respiration was kept up constantly and efficiently. Under the view which I was led to adopt by the results of the experiments, viz., that the sense of want of air was due to a deficiency of oxygen-carrying blood in the medulla oblongata, I could not be certain that the arterial blood was entirely shut off from the medulla without tying the innominate and the left subclavian. It seemed to make no difference in the results of the experiments whether the great veins were tied or left free. In all of the experiments, the excitability of the medulla was repeatedly shown by arresting artificial respiration from time to time. The animals began to make respiratory efforts in from thirty to forty-five seconds after the arrest of artificial respiration.

The results of my experiments show that, when the flow of oxygenated blood is cut off from the parts supplied by the vessels given off from the

arch of the aorta in a living animal, the sense of the want of air is excited —as is evident from the repeated and often violent respiratory efforts— although air is supplied to the lungs. Respiration will continue when all of the encephalic ganglia with the exception of the medulla oblongata have been removed; and it is well known that this (the medulla) is the sole respiratory nervous centre. We should naturally look, then, to influences operating upon the medulla oblongata for an explanation of these respiratory efforts. It does not seem that these movements can be due to an impression received by the medulla from the general system and due to want of oxygen; for, when the descending aorta is tied in the chest, no respiratory efforts are made. The movements, indeed, occur only when the medulla oblongata is deprived of blood; and the vessels which it is necessary to tie in order to produce this result involve a smaller part of the general systemic circulation than when the descending aorta is tied in the chest.

I do not assume that the view just enunciated is entirely novel, but, so far as I know, the observations made in 1877 were the first to sustain such a view by positive experimental evidence. Upon this point, I have nothing to add to what I have already stated in connection with the following quotations.[1]

"The first respiratory effort of the fœtus is thus produced by the interruption of the placental respiration, the sudden deficiency of oxygen and increase of carbonic acid in the blood (Schwartz). This change in the blood needs to take place locally only in the vessels of the medulla oblongata, in order to produce this effect; it occurs, for example, from arrest of the blood in these vessels (by ligature of the carotid arteries, Kussmaul and Tenner, Rosenthal, or by closure of the venous currents from the brain, Hermann and Escher), by which their blood becomes progressively poorer in oxygen and richer in carbonic acid" (Hermann, "Grundiss der Physiologie des Menschen," Berlin, 1870, S. 160).

"If the supply of blood be cut off from the medulla by ligature of the blood-vessels of the neck, dyspnœa is produced, though the operation produces no change in the blood generally, but simply affects the respiratory condition of the medulla itself, by cutting off its blood supply, the immediate result of which is an accumulation of carbonic acid and a paucity of available oxygen in the protoplasm of the nerve-cells in that region." (Foster, "A Text-Book of Physiology," New York, 1880, p. 377).

These quotations from Hermann and from Foster show clearly that their idea is that the sense of want of air is due to deficiency of oxygenated blood in the medulla oblongata, a view fully sustained by my own experiments. The observations of Kussmaul and Tenner, referred to by Hermann, were made with reference to the cause of the convulsions which so often occur after profuse and sudden hemorrhage. They are to be found in the elaborate memoir by Kussmaul and Tenner, "On the Nature and Origin of Epileptiform Convulsions caused by Profuse Bleeding," translated and published by the "New Sydenham Society," in 1859. Kussmaul and Tenner made a large number of experiments upon rabbits and horses, in which they observed the effects of tying the great vessels given off from the arch of the aorta. They noted, after this operation, great difficulty in respiration and violent convulsions. They did not, however, arrest the respiratory movements of the animal by artificial respiration, thus abolishing, for the time, the respiratory sense, and then note the effects of ligature of these vessels. The experiments by Rosenthal, which are referred to, are probably

[1] New York Medical Journal, November, 1877, vol. xxvi. p. 453.

those contained in his work "Die Athembewegungen und ihre Beziehungen zum Nervus Vagus," Berlin, 1862. In these experiments, as I have already stated, it is shown that the respiratory efforts of an animal can be abolished by forcing atmospheric air or oxygen in large quantities through the lungs, but that the sense of want of air is felt when, in place of oxygen, nitrogen or hydrogen is employed, by this means removing the possibility of an irritation from carbonic acid. These are essentially the same as the observations made by Pflüger, in 1868. Rosenthal states very distinctly that the sense of want of air is due to want of oxygen-carrying blood in the medulla oblongata; but he does not actually demonstrate the truth of this proposition by experiments. The statements by Hermann and by Foster are apparently based upon the experiments of Kussmaul and Tenner and of Rosenthal; but I must nevertheless claim that the experiments which I have made upon this subject, which will be detailed farther on, if they should be confirmed, afford the first positive proof that the respiratory sense may be excited by cutting off the arterial supply from the medulla. There is nothing which I can find, in the experiments of Kussmaul and Tenner or of Rosenthal, which actually shows that the sense of want of air is not due to a want of oxygen in the general system.

All the experiments that I have thus far referred to have of necessity involved placing the animals upon which the observations were made under conditions exceedingly unnatural. It cannot be assumed that, after the chest has been opened, the nerve-centres possess a degree of sensibility and a power of action entirely normal. Still, it is not easy to see how such a modification of the natural conditions can be avoided; and we must reason as best we can from the observations that have been made, keeping in view the experimental conditions.

It is certain that oxygen may be artificially supplied to the lungs in a living animal so efficiently as to abolish for the time the sense of want of fresh air to satisfy the requirements of the system for oxygen, and to cause all respiratory efforts on the part of the animal to cease.

When artificial respiration is arrested and the blood becomes dark in the arteries, when the blood is drained from the system, artificial respiration being continued, or when oxygenated blood is shut off from the medulla oblongata, the animal makes respiratory efforts.

Taking into consideration all the experiments bearing upon this point, they seem to show beyond question that, under the conditions indicated above, the sense of want of air, the stimulus, or whatever it may be that causes the animal to make respiratory efforts, depends upon some peculiar condition in the medulla oblongata.

Still, under the conditions mentioned; that is, an animal under the influence of ether with the chest opened and a bellows in the trachea, when artificial respiration is interrupted, the respiratory efforts begin in from thirty to forty-five seconds. We then have blood in the medulla oblongata, containing less oxygen and more carbonic acid than normal arterial blood and passing through the capillaries under great pressure, slowly and with difficulty. When, on the other hand, all the vessels given off from the arch of the aorta are tied, respiratory efforts begin in a few seconds more than two minutes. While this latter experiment, taken by itself, shows that shutting off the oxygen-carrying fluid from the

medulla oblongata excites the sense of want of air, the question at once arises, why, when the vessels which supply the medulla oblongata are filled with blood of a venous character, is the respiratory sense excited so much more promptly than when the arteries are tied? In other words, if it be assumed that shutting off the blood from the medulla oblongata will excite the respiratory sense by cutting off the supply of oxygen, and that this will induce respiratory efforts in about two minutes, why does the simple interruption of artificial respiration, which causes blood of a venous character to go to the medulla oblongata, induce respiratory efforts in about thirty seconds?

This is a question which I have in vain attempted to solve to my entire satisfaction. When artificial respiration is arrested and the circulation is not interfered with by the tying of vessels, the venous blood passes through the lungs and back to the left side of the heart without losing its carbonic acid and without receiving a fresh supply of oxygen. Under these conditions, it passes through the great vessels given off from the arch of the aorta to the medulla oblongata as well as to others parts; and the main obstruction to the blood-current, which produces such intense engorgement of the cardiac cavities, exists in the systemic capillaries. It is fair to infer that the capillaries of the medulla are engorged as well as others. This being the condition, it is logical to assume that the oxidizing processes which normally go on in the medulla are promptly arrested; and it may also be assumed, for sake of argument, that this arrest of oxidation excites the sense of want of air. It does not appear how any experiment can be devised in which the venous blood could be admitted in such quantity to the medulla, at the same time maintaining the normal supply of oxygen and the uninterrupted performance of normal oxidation in this particular part.

On the other hand, suppose that the great vessels given off from the arch of the aorta be tied. While the supply of fresh arterial blood is thus cut off from the medulla, it is well known that the contraction of the vessels beyond the point of ligation—which is slow and gradual, as is characteristic of non-striated muscular tissue—will still force the small quantity of blood which these vessels contain, through the medulla. My experiments show that the supply of arterial blood to the medulla need not be very considerable in order to satisfy the respiratory sense. Constriction of the innominate artery alone does not induce respiratory efforts. No respiratory efforts are made when both carotids and both vertebral arteries are constricted. These efforts, indeed, occur only when the innominate and the left subclavian are tied, or when ligatures are applied to both carotids, both vertebrals, and both subclavians.

Reasoning from these facts and inferences, the following is the only explanation that I can offer of the rapid excitation of respiratory efforts

by simple arrest of artificial respiration, as compared with the effects of tying the vessels given off from the arch of the aorta :—

When artificial respiration is interrupted, the normal oxidizing process in the medulla oblongata is promptly arrested and respiratory efforts begin in from thirty to forty-five seconds. When, on the other hand, the vessels which supply blood to the medulla are tied, the contraction of the muscular coats of the vessels beyond the points of ligation for a certain time forces a small quantity of arterial blood to the medulla, and it is only when this ceases that the want of oxygen is felt. This may be the reason why the arrest of oxidation in the medulla is later when the vessels are tied than when artificial respiration is interrupted.

When it is proven, as I think it has been proven conclusively, that an animal, after the respiratory movements have been arrested by artificial respiration, will make respiratory efforts when the supply of oxygen-carrying blood is shut off from the medulla oblongata, the question arises with regard to the application of this experimental fact to the mechanism of normal respiration.

Cause of the Normal Rhythmical Movements of Respiration.—The normal, rhythmical movements of respiration are excited and regulated by the medulla oblongata, which is the sole respiratory nervous centre. Under ordinary physiological conditions, the exciting cause of these movements, whatever it may be, is unconscious, and the muscular acts by which air is introduced into the lungs take place without efforts of the will. In other words, the movements of ordinary respiration are unconscious and involuntary. That these propositions are correct, has been proven by experiments that are perfectly familiar to physiologists. When all the nerve-centres that are known to have any relations to sensation and voluntary movements are destroyed, the medulla oblongata remaining intact, the rhythmical movements of respiration persist. When the medulla oblongata is destroyed, the other nerve-centres remaining intact, the respiratory movements are instantly arrested. The cause of this arrest of respiratory movements following destruction of the medulla is explained by the following proposition :—

The medulla oblongata is the only nerve-centre capable of appreciating the unconscious sense of want of air, and, consequently, when this centre is destroyed, the sense of want of air is not felt, and no true respiratory movements can be excited. In the same way, when oxygen is freely supplied to the blood of a living animal by artificial means, no sense of want of air exists and no respiratory efforts occur. In the fœtus *in utero*, so long as oxygen is supplied to the blood by the placenta, no respiratory efforts are made; but, when the placental circulation is interrupted, the sense of want of air is developed and respiratory efforts occur. This may take place, as is well known, before birth.

My experiments, published in 1877, show most conclusively that the

sense of want of air is developed and respiratory efforts are excited, not necessarily by a possible irritation due to the circulation of venous blood in the medulla oblongata, but by cutting off from the medulla the supply of oxygen. This occurs when the respiratory acts have been arrested by supplying air to the lungs artificially.

Under ordinary physiological conditions, the heart-beats numbering seventy-two, and the respirations eighteen per minute, the following is probably the mechanism of the flow of blood through the capillaries of the lungs and the vessels of the medulla oblongata:—

The venous blood from the general system is sent to the lungs by the action of the right ventricle, the intermittent force of which is destroyed by the elasticity of the pulmonary artery and its branches, until the current in the pulmonary capillaries becomes nearly or quite steady and continuous. This venous blood is poor or deficient in oxygen and rich in carbonic acid. As it passes through the lungs, it gives off its carbonic acid and appropriates oxygen. In the pulmonary parenchyma, the composition of the air is tolerably uniform; that is, it contains a certain proportion of oxygen and of carbonic acid gas. But, at the same time, the air in the pulmonary cells has a tendency to an increase in its proportion of carbonic acid with a diminution in its oxygen; for the venous blood, as it passes through the pulmonary capillaries, is constantly giving off carbonic acid and taking up oxygen. This tendency to a diminution in oxygen and an increase in carbonic acid in the contents of the air cells progressively increases from the completion of any single inspiratory act to the beginning of another. When, however, a new act of inspiration occurs, fresh oxygen is introduced into the lungs, which supplies the place of a certain quantity of carbonic acid thrown off by the preceding expiration. That this occurs is sufficiently evident; and it is illustrated by the fact that, when expiration is voluntarily retarded, the expired air becomes much richer in carbonic acid and poorer in oxygen than it is under ordinary conditions.

On the other hand, the left ventricle is sending arterial blood received from the lungs to all parts of the system, including the medulla oblongata. The elasticity of the aorta and of its branches gradually extinguishes or absorbs the intermittent force of the heart, so that the blood flows in a steady and continuous stream through the capillaries of the medulla. But, as the tendency of the air in the pulmonary parenchyma is to progressively increase its proportionate quantity of carbonic acid and to diminish its oxygen between two inspiratory acts, the tendency of the blood coming from the lungs and sent by the left ventricle to the medulla oblongata is to become progressively poorer in oxygen. After about four revolutions of the heart (assuming that the proportion of the beats of the heart to the respiratory acts are as four to one), the quantity of oxygen supplied to the medulla oblongata has become so far diminished that there

occurs an unconscious sense of want of air, and this excites a new inspiratory act. So it is, in all probability, that the normal, rhythmical acts of inspiration are periodically excited; and anything, like violent muscular exercise, that increases the activity of the consumption of oxygen, of necessity increases the number of respirations per minute.

In my opinion, in the explanation just given of the cause of the rhythmical acts of respiration, we have gone as far as we can, in the present condition of physiological knowledge, without becoming involved in unprofitable speculation and in a discussion of hypotheses not justified by established facts. All that we can at present positively assume to be true, is that respiratory movements are excited by a want of oxygen in the substance of the medulla oblongata; and I know of no reasonable theory which will explain the exact mode of action of the oxygen of the blood upon any of the anatomical elements of the respiratory nervous centre. Still, it may not be uninteresting to refer to an explanation, proposed by Pflüger[1] in 1868, and advanced again in 1878 by Burkart, the substance of which is contained in the following quotation:—

"1. The ganglionic cells of the respiratory centre produce, when there is a deficiency of oxygen, a readily oxidizable substance. 2. This substance performs its function, through a certain degree of production and accumulation, as a stimulus to the very cells that are concerned in its production. 3. The oxygen of the blood, that is of the tissues, operates against the production and accumulation, and consequently the stimulating action of this hypothetical substance thus restrained or removed. The capacity of the ganglionic cells to produce, in a greater or less degree, by a deficiency of oxygen, this substance which excites respiratory movements, is measured by the vital energy of the cells, as far as this vital energy, or better the energy of the process of oxidation, relates to the demand for oxygen on the part of the cells. The production of the hypothetical substance is merely the vital expression of the ganglionic cells of the respiratory centre through a deficiency in oxygen, and it ceases with the life of the cells themselves."[2]

The above quotation, which it was somewhat difficult to render into idiomatic English, embodies a theory which may be more clearly expressed as follows:—

The nerve-cells of the respiratory centre are constantly producing a hypothetical substance which acts as a stimulus to the muscles of inspiration. As the arterial blood passes through the capillaries of the medulla, its oxygen combines with this hypothetical substance, which is thus destroyed, or at least its action as a stimulus to the muscles of respiration is arrested. The quantity of this substance existing in the cells of the medulla is regulated by the supply of oxygen, and this regulates the degree of stimulation of the respiratory muscles. The production of this hypo-

[1] Pflüger, Ueber die Ursache der Athanbewegungen, sowie der Dyspnoë und Apnoë.—Archiv für die gesammte Physiologie, Bonn, 1868. Bd. i., S. 90.

[2] Burkart, Studien über die automatische Thätigkeit des Athemcentrums und über die Beziehungen desselben zum Nervus Vagus und anderen Athemnerven.—Archiv für die gesammte Physiologie, Bonn, 1878, Bd. xvi. S. 436.

thetical substance is a manifestation of the vital energy of the cells, and this production ceases with the life of the cells.

The theory which I have proposed involves the following simple propositions deduced mainly from my experiments published in 1877:—

1. When the respiratory nervous centre is fully supplied with oxygen by means of artificial respiration, this centre gives off no stimulus to the muscles of respiration and no respiratory efforts occur.

2. When there is a deficiency in the supply of oxygen to the respiratory nervous centre, the stimulus which gives rise to inspiratory efforts is generated, and this stimulus and the respiratory efforts which follow are active and vigorous in proportion to the extent and duration of the deficiency of oxygen.

3. In normal respiration, expiration being mainly passive, the rhythm and extent of the inspiratory acts are regulated by the quantity of oxygen supplied to the medulla oblongata. Thus, when there is a tendency to a deficiency of oxygen in the arterial blood, as its proportion must gradually and progressively diminish from the termination of one inspiratory act to the beginning of another, this need of oxygen, or unconscious sense of want of air, induces a stimulus which leads to the introduction of fresh air into the lungs.

4. As oxygen can get to the medulla oblongata only through the blood, serious disturbances of the circulation are always attended with an exaggeration of the respiratory sense, although the lungs may be freely supplied with pure air.

The theory of Burkart involves the assumption of the existence of a "readily-oxidizable substance" which the cells of the medulla oblongata have a constant tendency to produce and which the oxygen of the blood has a constant tendency to destroy. Burkart assumes that this hypothetical substance acts as a stimulus to the muscles of inspiration; I contend that we can go no farther in our explanation of the generation of the respiratory stimulus than to state the fact, which I have demonstrated experimentally, that the sense of want of air, be it unconscious, as in ordinary respiration, or conscious, as it is when we experience a sense of suffocation, is due to a deficiency in the supply of oxygen to the respiratory nervous centre.

Cause of the Conscious and Exaggerated Movements of Respiration in Dyspnœa.—In ordinary respiration, the sense of want of air, which is the starting point of the stimulus that gives rise to the respiratory acts, is entirely unconscious, and the acts of inspiration are involuntary and automatic. Even when there is a slight deficiency in the proper aëration of the blood, as occurs from the vitiated atmosphere of a crowded room, we experience merely an indefinite sense of oppression, and the respiratory movements are still of the same involuntary character. But when there occurs any serious interference with the passage of fresh air to the pulmonary parenchyma,

or an obstruction to the flow of arterial blood to the medulla oblongata, as in certain pulmonary and cardiac diseases, the sense of want of air is exaggerated until we become conscious of pulmonary oppression or impending suffocation. Under such conditions, many muscles that are not usually brought into action in inspiration are used, partly by an effort of the will. This is simply an exaltation and extension of the normal respiratory sense, so that it reaches the true centres of sensation, causing a voluntary increase in the number and extent of the inspiratory acts. The sense of suffocation, indeed, differs from the normal unconscious respiratory sense merely in degree, and in the fact that the former operates on the centres of ordinary sensation through sensory nerves, while the latter is confined to the medulla oblongata. Having once ascertained definitely the cause of the normal sense of want of air, we can readily understand how an exaggeration of the conditions which give rise to the natural automatic movements of respiration may produce those sensations which attend the various degrees of suffocation. As more remote consequences of asphyxia, we observe insensibility, an arrest of the circulation by engorgement of the heart, and finally the sensibility of the medulla oblongata disappears. As a general rule, when the action of the heart has ceased from asphyxia, even the most efficient artificial respiration fails to restore the respiratory function, for the reason that it is only by the action of the heart that blood can be sent to the medulla. While, however, the heart continues to act, although its contractions may be very feeble, it is within the limits of possibility to revive the functions of the medulla by artificial respiration.

There are certain agents which seem to affect the medulla directly, such as narcotics and anæsthetics. In poisoning by opium, the frequency of the respiratory acts is diminished and they may be arrested. All experimenters must have frequently observed arrest of respiration by the administration of anæsthetics to animals. In such instances, if the heart continue to beat, it is generally possible to revive the respiratory function by artificial insufflation of the lungs. In most cases of suspended respiratory action from any temporary cause, although galvanism, sudden and active stimulation of the surface, etc., may aid in restoration, the main reliance should be upon persistent and efficient artificial respiration.

Cause of the first Respiratory Act after Birth and of Respiratory Efforts in Utero.—No one doubts, at the present day, that the blood from the placenta furnishes to the fœtus *in utero* all the oxygen demanded for the function of respiration; and it is unnecessary to cite authorities to show that the blood of the umbilical vein contains oxygen, as this fact has long since been established. If the uterus of an animal far advanced in gestation be opened, an experiment which I have frequently made upon cats and dogs, the fœtuses for a time will make no respiratory efforts; but compression of the umbilical vessels of one will cause it to make very violent movements of inspiration, while the others will remain quiet so long as the pla-

cental circulation is uninterrupted. The umbilical vein carries its blood to the vena cava ascendens, thence to the left side of the heart through the foramen ovale, and thence to the upper extremities and head, including, of course, the medulla oblongata. Thus the blood that is most highly oxygenated is supplied to the medulla; and the aorta below the arch receives, through the ductus arteriosus, the blood from the right ventricle, which contains a much smaller quantity of oxygen than the blood distributed through the vessels given off above. Cutting off the flow of blood from the placenta is almost equivalent, therefore, to tying the vessels of the arch of the aorta. When this is done, the flow of oxygenated blood to the medulla is arrested, and there follows a sense of want of air which induces a stimulus that is sent to the muscles of inspiration. Air is then for the first time taken into the lungs, and the conditions of the circulation are changed. The lungs are now distended with air, and the pulmonary vessels are dilated, so that the right ventricle supplies the pulmonary capillaries, instead of sending the venous blood, as before, in greatest part through the ductus arteriosus. The pulmonary circulation being thus established, the conditions rapidly assume the character observed in the adult.

It is evident, from the experiments already noted, showing the effects of compression of the umbilical vessels, that an abnormal condition *in utero*, in which there is serious interference with the placental circulation, may induce inspiratory efforts in the fœtus, and that the liquor amnii may thus find its way into the air-passages.

Are the Normal Respiratory Movements either entirely or in part Reflex, in the Sense in which the term Reflex is ordinarily understood by Physiologists?—This question is the one which naturally arises as a logical sequence of the experiments I have described and of the deductions that I have drawn from the ascertained facts. The most important of these facts is the following: When the medulla oblongata is freely supplied with oxygen-carrying blood in a living animal, this being effected by artificial insufflation of the lungs, there are no inspiratory efforts. The animal makes respiratory efforts as the supply of oxygen to the medulla diminishes; and the want of oxygen alone is capable of inducing the stimulus to the muscles, which gives rise to the efforts to introduce air into the lungs. It is evident that the stimulus, under these experimental conditions, which was formerly thought to be reflex and produced by a certain impression conveyed to the medulla by centripetal nerves, really takes its origin in the medulla itself; that the respiratory sense, so called, is due to some alteration in the conditions of the medulla, which depends upon the supply of oxygen-carrying blood; and, finally, that this alteration does not of necessity involve any impression received through afferent nerves. Viewed in this way, when a living animal, in which the respiratory movements have been for the time arrested by artificial insufflation of the lungs, makes inspi-

ratory efforts following the operation of shutting off the blood-supply from the medulla, the stimulus which gives rise to these efforts cannot properly be called reflex.

I shall leave out of the question under consideration various modifications of the respiratory acts, such as coughing, sneezing, etc., and the influence of certain unusual impressions made upon the surface, as by a cold douche, restricting the discussion to the normal respiratory movements.

It is well known that a relatively strong galvanic current applied to the pneumogastric nerves in the neck or to certain branches of the pneumogastrics (the superior and the inferior laryngeals), will instantly arrest respiration. This action is reflex, as is shown by the fact that galvanization of the central ends of the divided nerves influences respiration, while the stimulus applied to the peripheral ends has no effect. The effect of powerful galvanization of the pneumogastrics and of certain of their branches is marked and constant; at the same time, galvanic stimulation of some of the nerves of general sensibility has been observed to arrest respiratory movements, although this result is not invariable. When the respiratory movements are completely arrested by galvanization of the pneumogastrics, it is always the same for the general movements of the animal, which remains motionless.[1] On the other hand, "a feeble excitation accelerates the respiration; a more powerful excitation retards it; a very powerful excitation arrests it. These words 'feeble' and 'powerful' having, it is understood, only a relative sense for any one animal, and under certain conditions: what is feeble for one would be powerful for another, etc."[2]

As far as we can apply these experimental facts to the physiology of ordinary respiration, it seems that the nerves, the action of which is brought into play under physiological conditions, must be mainly, if not exclusively, the pneumogastrics. These nerves have their origin at the medulla oblongata, which undoubtedly is the sole respiratory nervous centre; they are distributed to the entire respiratory apparatus from the larynx to the deepest parts of the lungs; they are the only nerves belonging to the cerebro-spinal system that are distributed to the larynx, trachea, bronchi, and the pulmonary parenchyma; while they are not distributed to the respiratory muscles, except the intrinsic muscles of the larynx, they are capable, by reflex action, of exerting a very marked influence over the respiratory movements. In discussing, then, the question of reflex nervous action in normal respiration, the argument may properly be confined to the pneumogastrics.

The curious and interesting respiratory phenomena observed in living animals after section of both pneumogastrics are very important. When both pneumogastrics are divided in the neck, the excitation directly produced by their section momentarily accelerates the respiratory movements.

[1] Bert, Leçons sur la physiologie comparée de la respiration, Paris, 1870, p. 490.
[2] Bert, *loc. cit.*

In very young animals, in which the cartilages of the larynx are comparatively soft and pliable, the paralysis of the inferior laryngeal nerves, which preside over the respiratory movements of the glottis, often produce speedy suffocation from closure of the glottis during the inspiratory act; but in most adult animals the walls of the larynx are sufficiently rigid to enable the acts of inspiration to be carried on without serious obstruction. In such animals, for a few seconds, the number of respiratory acts may be increased, but as soon as they become tranquil, the number is very much diminished, and the movements change their character. The inspiratory acts become unusually profound and are attended with excessive dilatation of the thorax. Under these conditions, I have seen the number of respirations fall from sixteen or eighteen to four per minute.

In discussing the possible reflex influences upon the normal respiratory movements which may operate through the pneumogastrics, I shall make use of a very interesting suggestion made by Rosenbach, in 1878. In a brief note upon the "Influence of Stimulation of the Vagus upon Respiration," Rosenbach proposes the theory that this nerve (the vagus) is the vaso-motor nerve of the medulla oblongata, and that it contains fibres which contract, and fibres which dilate the bloodvessels. This idea is presented by Rosenbach simply as an hypothesis, which he "hopes later to be able to establish by experiments."[1]

I may now state, in continuing my argument, the following propositions, all of which, except the last, I assume to be facts that have been established experimentally:—

1. A deficiency in the quantity of oxygen supplied to the medulla oblongata through the arterial blood circulating in its substance will, of itself, give rise to a stimulation of the muscles concerned in the act of inspiration.

2. A relatively feeble galvanic stimulation of the pneumogastric nerves increases the frequency of the inspiratory acts; a stronger stimulation may diminish their frequency; and a very powerful stimulation arrests the respiratory movements. The action in these instances is reflex and not direct.

3. Section of both pneumogastric nerves in the neck, in most adult animals, very greatly diminishes the frequency of the respiratory acts.

4. The pneumogastric nerves possibly contain vaso-motor filaments which are capable of regulating and modifying the supply of blood to the vessels of the medulla oblongata.

If these propositions be taken as the basis of a theory of the mechanism of normal respiration, the following seem to be the natural and logical conclusions to be drawn from them:—

[1] Rosenbach, Notiz uber den Einfluss der Vagusreizung auf die Athmung. Archiv für die gesammte Physiologie, Bonn, 1878, Bd. xvi., S. 503.

1. When the action of the medulla oblongata is removed from the influence of the pneumogastric nerves, as it is after division of both of these nerves in the neck, air is taken into the lungs when the deficiency of oxygen in the medulla has reached the point at which the respiratory sense necessarily generates the stimulus sent to the inspiratory muscles. This action is in no sense reflex, and it depends entirely upon the development, *de novo*, of a stimulation or an irritation in the medulla itself. Under these conditions, the acts of inspiration are abnormally infrequent, and they become excessively prolonged and profound.

In normal respiration, however, it is certain that important reflex influences operate upon the medulla oblongata through the pneumogastric nerves. While there can be no doubt that the stimulus which gives rise to inspiratory efforts is due purely and simply to want of oxygen in the medulla, in order that this stimulus shall operate in accordance with the requirements of the system for oxygen, producing normally from sixteen to twenty inspirations per minute, and varying the number of these movements with different physiological conditions of the organism, depending upon muscular exercise, etc., it is necessary that the respiratory acts should be regulated through the nervous system. Inasmuch as the respiratory acts involve the contraction of the striated muscular fibres, it would be expected that the nerves which regulate them should belong to the cerebro-spinal system. In studying experimentally the influence of various nerves upon the respiratory movements, it is found that the pneumogastrics, which arise from the medulla and are distributed largely to the respiratory apparatus, are closely connected with certain artificially-induced modifications of respiratory action. By applying to these nerves galvanic stimulation of different degrees of intensity, the respiratory movements may be increased or diminished in frequency, or they may be arrested, and these phenomena are always reflex.

Section of both pneumogastric nerves seems to remove the medulla oblongata, so far as its action as a respiratory nervous centre is concerned, from the reflex action of the nervous system; and the respiratory acts then become so far diminished in frequency and are so laboured as to produce serious pulmonary lesions. It is probable that death occurs in a few days after this operation, not alone from abnormal respiratory action, but from a suspension of other important functions which the pneumogastrics have to perform. It is possible, also, that some of the phenomena which are observed in narcotic poisoning, notably the great diminution in the number of respiratory movements, are due to an interference with the respiratory functions of the pneumogastrics.

The precise mechanism of the action of the pneumogastrics in normal respiration, and the exact seat and character of the impressions which serve as the starting point in the reflex phenomena observed, it is difficult to describe within the limits of ascertained facts. If the theory advanced by

Rosenbach be accepted; viz., that the pneumogastrics contain vaso-motor filaments which regulate the quantity of blood passing through the medulla oblongata, the mechanism of the action which takes place in the respiratory nervous centre is readily understood; but the seat and the exact nature of the impression which gives rise to these reflex changes in the calibre of the vessels are still a matter of speculation and conjecture. As far as muscular action in tranquil respiration is concerned, it is necessary to consider only the acts of inspiration, for expiration is produced mainly by the passive action of the walls of the thorax and by the resiliency of the elastic pulmonary parenchyma succeeding the action of the muscles which enlarge the chest and inflate the lungs.

Finally, the respiratory sense, *besoin de respirer*, sense of want of air, or the stimulus which gives rise to inspiratory efforts, is due purely and simply to a deficiency in oxygen in the medulla oblongata, which is the sole respiratory nervous centre. The frequency and the extent of the normal inspiratory movements are regulated and accommodated to the physiological requirements of the system by reflex action operating through the pneumogastric nerves.

In this article, I have endeavoured to set forth the nature and the physiological bearings of my experiments, published in 1877, showing that the sense of want of air is due primarily to a deficiency of oxygen in the medulla oblongata. I have attempted, also, to show how the operation of the stimulus to the inspiratory muscles, which is due to this deficiency of oxygen in the medulla, is regulated, in normal respiration, by reflex action through the pneumogastric nerves. Physiologists are now well acquainted with the functions of the pneumogastrics in connection with the circulation, the action of the stomach and intestines, and certain functions of the liver; but the action of these nerves in normal respiration and the causes of the respiratory phenomena following their galvanization and their section have heretofore been obscure. I venture to hope that my discussion of the reflex function of the pneumogastrics, in connection with the respiratory movements, has thrown some light upon questions which have not been fully understood by physiologists.

ARTICLE IV.

THE DIAPHRAGM: A PROTECTOR OF THE HEART AND CARDIAC VESSELS; ITS INFLUENCE ON THE ORGANS OF CIRCULATION. A paper read before the College of Physicians of Philadelphia, May 8. By W. S. FORBES, M.D., Fellow of the College, Senior Surgeon to the Episcopal Hospital, and Demonstrator of Anatomy in Jefferson Medical College, Philadelphia.

ON opening the thorax and abdomen in living cats and dogs, while under the influence of ether, for the purpose of examining the motions of

the heart, I have observed that the vena cava inferior opening through the pericardium and into the right auricle is held in a fixed relation to the vertebral column. Observing this fact I was induced to examine the vena cava inferior opening in the diaphragm, and its relation to the vertebral column in the human body.

I find that the vena cava inferior opening in the diaphragm of man is stationary, and holds a constant and fixed relation to the inferior part of the right antero-lateral margin of the ninth dorsal vertebra, and that it is not moved upwards nor downwards from its position by the surrounding organs in the performance of their function.

The diaphragm is a thin musculo-tendinous partition placed obliquely between the abdominal and thoracic cavities. It forms the floor of the thorax and the roof of the abdomen.

It is elliptical in shape, its largest diameter being from side to side. It consists of muscular fibres which arch upwards as they converge from the circumference of the abdominal cavity to the marginal under surface of a tendinous structure in the centre. The muscular fibres arise, in front, by two short muscular slips, one on either side of the middle line, from the ensiform cartilage of the sternum; those placed more laterally are attached to the inner surface of the cartilages and bony portions of the seven inferior ribs, interdigitating with the transversalis abdominis; behind they are attached to two aponeurotic arches, named the ligamentum arctuatum internum and externum; and on either side of the middle line posteriorly they are attached, by means of two thick tendinous crura, to the bodies and interposed fibro-cartilages of the upper lumbar vertebra; the one on the right side to the first, second, and third, and the one on the left side to the second and third lumbar vertebræ. The tendons of both these crura curve forwards and upwards and unite in forming an arch over the aorta, which is placed between the crura and in front of the vertebræ and under the tendinous arch. Muscular fibres spring from the anterior aspect of these tendinous crura in two thick bundles and diverge as they pass upwards to the aponeurotic centre. They are called the pillars of the diaphragm. The innermost muscular fibres of each crus pass upwards and inwards and thus decussate with each other, those of the right side usually lying anterior to those of the left side, and curving upwards they limit an opening for the transmission of the œsophagus before ending in the central tendon.

The ligamentum arctuatum internum is a fibrous band which extends from the body to the transverse process of the first lumbar vertebra, and arches over the upper part of the psoas muscle.

The ligamentum arctuatum externum extends outwards from the transverse process of the first lumbar vertebra to the last rib, arching over the front of the quadratus lumborum. From both ligamenta arctuata diaphragmatic muscular fibres take their origin, and are directed upwards to the posterior part of the tendinous centre of the organ.

The two short muscular fibres coming from the ensiform cartilage form a narrow slip on each side of which there occurs an interval, in which the lining membranes of the thorax and abdomen are separated only by a small quantity of loose connective tissue. Consequently we find here a weak point through which diaphragmatic hernia may take place.

The central tendon or cordiform tendon is a strong aponeurosis forming the central part of the diaphragm. It is elongated from side to side, and consists of three leaflets, partly separated by indentations; the right leaflet is the largest, the middle one is placed anteriorly, and the left which is elongated and narrow is the smallest of the three.

The central tendon is surrounded on every side by the muscular portion of the diaphragm, the fibres of which are directly continuous with those of the tendon.

There are in the diaphragm three large openings for the passage respectively of the aorta, the œsophagus, and the inferior vena cava; besides, some smaller holes or fissures which are less regular.

The opening for the aorta (hiatus aorticus) is not a complete foramen in the diaphragm, being an osseo-aponeurotic opening formed by the tendinous arch thrown across the front of the bodies of the vertebræ from the crus on one side to that of the other. It is, consequently, behind the diaphragm. It transmits the aorta, vena azygos major, the thoracic duct, and, occasionally, the left sympathetic nerve. It is the most inferior of the three openings of the diaphragm.

The œsophageal foramen is placed above, and, at the same time, anterior, and a little to the left of the aortic opening. It is elliptical in form, muscular in structure, and bounded by the muscular fibres coming from the two crura. Its anterior margin is occasionally tendinous. It transmits the œsophagus and the pneumogastric nerves.

The foramen for the ascending vena cava is the highest of the openings of the diaphragm. It is more or less quadrilateral in form, tendinous in structure, and placed posteriorly at the junction of the right and middle leaflets of the central tendon. Its margins are bounded by four bundles of tendinous fibres which meet nearly at right angles.

The right crus transmits the sympathetic and the greater and lesser splanchnic nerves of the right side; the left crus transmits the greater and lesser splanchnic nerves of the left side and the vena azygos minor. The serous membranes of the diaphragm are four in number, three lining its upper or thoracic surface and one its abdominal surface. Those on its upper part are the pleura on either side, and the serous layer of the pericardium, which covers the middle portion of the tendinous centre.

The serous membrane which covers the under surface is a portion of the general peritoneal membrane of the abdominal cavity.

The diaphragm is arched, being convex towards the thorax and concave towards the abdomen. Its left portion is lower than the right by about

three-quarters of an inch. It supports the base of the left lung and covers the great end of the stomach, the spleen, and the left kidney.

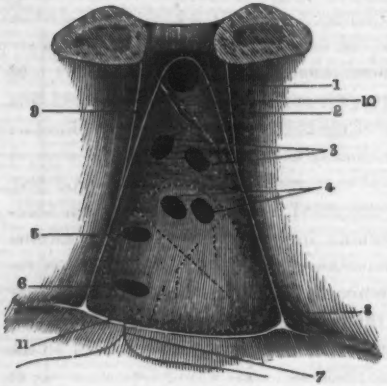
The right portion forms a complete arch from before backwards. It supports the base of the right lung, and is immediately over the convex surface of the liver. The central leaflet supports the heart, is higher in front at the sternum and behind at the vertebræ than the lateral leaflets.

The pericardium is a conical membranous sac in which the heart and commencement of the great bloodvessels are contained. The base of this sac is attached to the upper surface of the central tendon of the diaphragm; and on its anterior left side the muscular fibres of the diaphragm ascend on the pericardium and are attached to it, and in the new-born child play an important part to be hereafter described. The pericardium is a fibro-serous sac consisting of two layers, an internal serous and an external fibrous membrane. The serous membrane invests the heart, and is reflected on the inner surface of the fibrous membrane and over the upper surface of the central tendon of the diaphragm embraced by the fibrous membrane. The fibrous membrane firmly and intimately attached to the central tendon of the diaphragm ascends and converging forms a cone, at the apex of which the great bloodvessels issuing from and going to the heart are supported in their relative position by means of transverse and oblique bands of fibrous tissue which are continued on the walls of these vessels in the form of tubular prolongations, and which are gradually lost upon their external coat; the largest and strongest of these tubular prolongations is the one inclosing the aorta.

From the right and left external lateral surfaces of the fibrous membrane of the pericardium, and from near the apex of the pericardial cone, prolongations of the fibrous tissues continue upwards as strong bands, forming the antero-lateral parietes of the superior portion of the posterior mediastinal space and reaching the inner aspect of the first rib on each side, and coalescing with the thoracic fascia of Sir Astley Cooper, are held in a fixed position by this fascia which is stretched across the apex of the thoracic cone. These two strong bands continuous with the lateral portion of the pericardium thus form fibrous planes reaching from each side of the central tendon of the diaphragm to the bony apex of the thoracic cone. They form what may be called the superior tendinous crura of the diaphragm, upon the sides of which the phrenic nerves descend to reach the diaphragm; and by means of transverse and oblique bands of fibrous tissue connecting these tendinous crura together at and above the pericardial cone, a strong fibrous scaffolding is formed on which the great cardiac vessels are supported and protected. These superior tendinous crura of the diaphragm are inextensible. Each crus of the diaphragm is fixed above to the bony apex of the thoracic cone, and by fibrous connection, to the thoracic fascia of Sir Astley Cooper, which is stretched across the thoracic apex. The thoracic fascia of Cooper is supported above by the deep cervical fascia,

which is strongly attached to the processes of the cervical vertebræ and to the stylo-maxillary ligament on each side of the base of the skull. "The thoracic fascia," writes Sir Astley Cooper, in his work on the Anatomy of the Thymus Gland, "performs three important offices: 1st. It forms the upper boundary of the chest, as the diaphragm does the lower. 2d. It steadily preserves the relative situation of the parts which enter and quit the thoracic opening. 3d. It attaches and supports the heart in its situation through the medium of its connection with the aorta and larger vessels which are placed at its curvature."

Fig. 1.



The above wood-cut represents a vertical section of the pericardium and diaphragm. The heart and the serous pericardium are removed showing the openings for the lodgment in the fibrous scaffolding: 1, aorta; 2, ductus arteriosus compressed in its elliptical opening, divided and turned up; 3, right and left pulmonary arteries; 4, pulmonary veins; 5, superior vena cava; 6, inferior vena cava opening into diaphragm. 7. Suspensory ligament of liver, the section is at a point midway between the cava opening in the diaphragm and the abdominal wall. 8, muscular fibres ascending on anterior left aspect of pericardium; 9 and 10, fibrous planes ascending laterally from pericardium to reach the apex of bony thoracic cone. 11, cordiform or tendinous portion of diaphragm below the heart.

In continuing downwards and connecting itself with the lateral and superior parts of the pericardium the thoracic fascia forms on either side a membranous continuity with the diaphragm, and in connection with that organ performs an important function on the circulatory apparatus.

The muscular fibres at the circumference of the diaphragm contracting, and the pericardial portion of the central tendon being fixed on a plane with the lower part of the body of the ninth dorsal vertebra, which cannot descend on account of the superior crura and the fibrous scaffolding which I have pointed out, the following parts are acted upon: the aortic arch of the diaphragm is drawn forward and made more free; the muscular œsophageal opening is contracted; the tendinous vena cava opening is held open to its fullest extent. Continuing to contract, the muscular circumference of the diaphragm now exerts its force on the pericardium and the superior crura or lateral fibrous planes, and upon the fibrous scaffolding between these crura, thus holding it open and tense, open to allow the flow of blood to and from the heart, and tense in order to protect the heart and bloodvessels, which if not protected would have their function greatly impaired by pressure on the part of the now expanding lungs. These functions of the diaphragm on the organs of circulation take place

though the lateral portions of the diaphragm may not be permitted to descend on account of the contraction of the stronger abdominal muscles or from artificial restraint of the abdominal walls. The muscular diaphragm will contract on its own planes and still perform its functions for the benefit of the vascular apparatus, though it may be prevented from descending, thus extending the vertical area of the respiratory organs.

The right superior fibrous crus of the diaphragm is vertical in its direction. It is at the foot of this crus, and on its inner aspect, that we find the vena cava opening of the diaphragm. It is the right superior inextensible crus which holds up under the concave surface of the diaphragm the entire weight of the liver, an organ in the adult of four pounds avoirdupois. The falciform or suspension ligament of the liver is formed by two folds of the peritoneum reflected from each inferior lateral margin of the fibrous vena cava opening in the diaphragm down to the lateral margins of the vena cava fissure in the liver; the two folds meeting in front of the vena cava form the apex or point of the falciform ligament, which here is very short, holding the vena cava fissure in the liver close up to the vena cava opening in the diaphragm.

At this point, the apex of the falciform ligament, behind which the vena cava issues from its fissure in the liver to ascend to its diaphragmatic opening, the liver cannot descend. The base or anterior aspect of the falciform ligament is broad, and permits the anterior margin of the liver to fall and then to be elevated to and behind the ensiform cartilage by the action of the abdominal muscles. The lateral wings of the diaphragm and the muscular parietes of the abdomen in contracting and relaxing make lateral pressure upon the liver, and thus in a most positive manner advance the venous circulation and the flow of bile in the parenchyma of the liver, for the walls of the vessels in which these fluids are lodged have no muscular tissue.

In the very young fœtus the thorax and abdomen form one cavity as in birds, reptiles, and fishes. The diaphragm in the fœtus is developed by a process of growth from the circumference to the centre, and when developed is in a passive state until birth. In the neonatus the muscular diaphragm is called into immediate action, and in contracting performs at once a most important function in compressing the ductus arteriosus, thereby diverting the current of blood into the two branches of the pulmonary artery, which go respectively to the right and left lung. The peculiarities in the arterial system of the fœtus are the communication between the internal iliac arteries and the placenta by means of the umbilical arteries, and the communication between the pulmonary artery and upper part of the descending portion of the arch of the aorta by means of the ductus arteriosus. In the fœtus and up to the birth of the neonatus the right and left branches of the pulmonary artery are, relative to the main pulmonary artery, very small, and come off from the posterior

aspect of the artery while the ductus arteriosus is in front of them nearer the sternum, and is much larger, and is in fact the continuation of the main pulmonary artery to the arch of the aorta, into which it opens just below the origin of the left subclavian artery, and so conducts the current of blood from the right ventricle into the descending aorta.

The ductus arteriosus is lodged in an elliptical opening in the fibrous scaffolding beneath the descending portion of the arch of the aorta, which opening extends obliquely from above downwards and forwards and to the left, going in front of the descending aorta behind the "vestigial fold" of Marshall (which is formed by a duplication of the serous membrane between the pulmonary artery and the subjacent pulmonary vein), and above the left branch of the pulmonary artery. The tendinous fibres forming the margins of this elliptical opening embrace the ductus arteriosus and are connected to its external coat by connective tissue; they extend from the inner aspect of the superior posterior margin of the right fibrous plane or crus, downwards and forwards and to the left to become attached anteriorly and below to the inner surface of the left fibrous plane or crus, and the muscular fibres of the diaphragm contracting at the first inspiration at birth the tendinous fibres of the elliptical opening are made to compress the ductus arteriosus and eventually close it. Especially is this compression made by the contraction of those muscular fibres of the diaphragm which ascend upon and are attached to the anterior left aspect of the pericardium. The alternate pressure and relaxation made on the ductus arteriosus by the contraction of that part of the muscular diaphragm referred to is exactly similar to the procedure we now adopt in closing by pressure, sufficient for the formation of a clot, the main artery in cases of aneurismal tumours, and the effect in both instances is exactly the same; in cases of aneurismal tumours while the clot is being formed the collateral circulation is being established by the distension and permanent enlargement of the collateral branches on the cardiac side of the point of pressure, though these branches are lodged in far denser tissue than the undistended fœtal lung.

When the ductus arteriosus is being compressed by the margins of the fibrous opening in the fibrous scaffolding in which it is lodged, drawn upon by the muscular tissue alluded to, and while the clot is being formed, the right and left pulmonary branches going to the lungs are being distended and permanently enlarged until their united capacity is equal to the entire volume of blood in the main pulmonary stem, and thus the collateral circulation is eventually established with the aorta by means of the appropriate organs. The ductus arteriosus in the mean time is filled with the clot becoming organized, which permanently closes it. We may believe that in the case of the compressed ductus arteriosus, the collateral circulation with the aorta would take place though the lungs did not ex-

pand, just as the collateral circulation would be established on ligating any other artery, one in the extremities for instance. In short the expansion of the lungs, *per se*, has nothing to do with the closure of the ductus arteriosus. The expansion of the lungs is for the aëration of the blood, and they are made to expand by muscles of respiration independent of the descent of the diaphragm, and we may believe the closure of the ductus arteriosus and the collateral circulation with the aorta would be established by reason of the contraction of the diaphragm, though this diaphragm were restrained from descending.

The line of pressure exerted on the ductus arteriosus is nearer to the aorta than to the two branches of the pulmonary artery. The clot soon becomes firm and the closure of the duct is made complete by the eighth day.

Fig. 2.

Heart of infant showing the mode of disappearance of the ductus arteriosus after birth. 1. Aorta. 2. Pulmonary artery. 3, 3. Pulmonary branches. 4. Ductus arteriosus becoming obliterated. (After Dalton.)

The further influence of the muscular lamina, attached to the anterior left aspect of the pericardium on the fibrous surrounding of the ductus arteriosus, is observed in the future development of the branches of the pulmonary artery, for at maturity or in the adult the fibrous cord, the remains of the former ductus arteriosus, is found reaching from the aorta to near the root of the left branch of the pulmonary artery, the muscular lamina on the pericardium having drawn it in that direction away from its former situation in a line with the long axis of the main pulmonary artery. Sometimes, indeed, the fibrous cord is entirely removed by absorption following this pressure, and no vestige of the former organ is to be seen.

Such is the function performed by the contraction of the muscular diaphragm on the ductus arteriosus and on the pulmonary circulation of the new-born child. "*Post cor facile princeps.*"

When the lateral wings of the diaphragm, contracting, are permitted to descend, then and not until then do they tend to form a vacuum in the thorax, and thus assist to promote the venous circulation in the thorax and consequently in the whole venous system in the body. The first and most continuous effect of the contraction of the diaphragm, whether it is permitted to descend or not, is for the protection of the central circulatory apparatus, and the promotion of the circulation of the blood. If the diaphragm is injured the result of that injury is experienced first by the heart. This fact is verified in the clinical histories of injuries of the phrenic nerve and the diaphragm. Thus, it is well illustrated in the case recorded by Mr. Pollock in Holmes's *System of Surgery*, vol. ii. p. 650,

as being under the care of Mr. Cæsar Hawkins, in St. George's Hospital. If one side of the diaphragm is lacerated, or if there is unilateral paralysis of the diaphragm, the heart is pushed over to the opposite side of the thorax by the expanding lung, the lateral fibrous scaffolding being no longer supported on the side of the paralysis. In bilateral paralysis the heart is pushed backwards by the lungs advancing in front of it, and during inspiration the epigastrium and hypochondria are depressed, the heart, with the pericardium and its attachments to the diaphragm in front and at the base of the thoracic cone, being carried backwards by lung pressure in front; the anterior and lateral attachment of the diaphragm cause the depression of the epigastrium and hypochondria, phenomena so characteristic of bilateral paralysis. Duchenne informs us that if in these cases the phrenic nerves be galvanized the diaphragm acts again with proper strength, and during inspiration the thoracic and abdominal walls rise simultaneously.

The descent of the diaphragm is not necessary to respiration, this is manifest from ordinary observation; but the contraction of the diaphragm, though it may not be permitted to descend, is necessary in order to protect the heart from the movement of surrounding viscera, and in order to promote the free circulation of the blood through the vessels forming the cardiac roots.

From this view, then, of the anatomy and functions of the diaphragm, this organ may be classed rather as an appendage to the circulatory apparatus, and not as the chief agent of respiration as heretofore believed. The natural history of the diaphragm would tend to confirm this view. It is found first in mammals. These animals require a diaphragm to protect the central organ of circulation from the encroachment of the neighbouring lungs and abdominal viscera, and by its contracting to act in promoting as well as protecting the functions of the heart. In birds and in turtles and tortoises, such an organ as the diaphragm is not required. In these animals the thoracic and abdominal viscera are in one and the same cavity, but the movement of the lungs is limited by means of pleural attachments, and the heart and its great vessels are protected by peritoneal folds which form restrictions by being attached to distant points of a rather fixed bony framework. In them the diaphragm is not found, as it is not needed.

In the foregoing remarks we have endeavoured to demonstrate that—

1st. The vena cava inferior opening, the highest point in the central tendon of the human diaphragm, holds a constant and fixed relation to the right anterior inferior border of the ninth dorsal vertebra.

2d. That portion of the central tendon embraced by the base of the fibrous pericardium is prevented from descending in inspiration by the superior tendinous crura of the diaphragm which are formed by the lateral parts of the fibrous pericardium ascending on either side in two planes to be attached to the apex of the bony thoracic cone and through the deep

cervical fascia to the processes of the cervical vertebræ, and to each stylo-maxillary ligament.

3d. These superior tendinous crura of the diaphragm are connected together by transverse and oblique fibrous bands, thus forming a fibrous scaffolding for the support and protection of the heart and the great cardiac vessels.

4th. The opening in the fibrous scaffolding for the lodgment of the ductus arteriosus in fœtal life is closed by the contraction of the muscular fibres ascending on the fibrous pericardium from the anterior left side of the diaphragm in the neonatus.

5th. The blood in the pulmonary artery of the neonatus is *forced* into and through the right and left pulmonary arteries and into the lungs by the contraction of the right ventricle, which at this moment has its walls as thick as those of the left ventricle, and by the elasticity of the pulmonary artery, and is not *drawn* into the pulmonary arterial branches and into the lungs by the expansion of the lungs.

6th. The superior fibrous crura and the fibrous scaffolding between them are made tense and open for the lodgment and for the protection of the heart and its great vessels, and for the promotion of the circulation of the blood through them by the contraction of the muscular diaphragm, independent of the descent of its lateral wings, though in the descent of the lateral wings of the diaphragm the vertical area of the thorax is extended.

7th. In the contraction of the muscular diaphragm its descent is not necessary as it contracts on its own planes, which may be supported by the contraction of the stronger abdominal muscles.

8th. The diaphragm is rather an appendage of the circulatory apparatus, and not "essentially the chief agent in respiration."

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ARTICLE V.

A CASE OF FISTULA OF STENO'S DUCT FOLLOWING GUNSHOT WOUND, SUCCESSFULLY TREATED BY DISSECTING UP THE POSTERIOR EXTREMITY OF THE DUCT AND CONDUCTING IT INTO THE MOUTH, AFTER THE METHOD OF LANGENBECK, WITH SOME REMARKS UPON THE TREATMENT OF SALIVARY FISTULÆ.

By ERSKINE MASON, M.D., Surgeon to Bellevue and the Roosevelt Hospitals, Clinical Professor of Surgery Bellevue Hospital Medical College, New York.

ON the afternoon of Sept. 8, 1870, I was summoned out of the city to see a boy fifteen years of age, who, a few hours before, had been wounded by the accidental discharge of his gun, which was loaded with duck shot. He was in the attitude of leaning over the barrel at the time the discharge

took place. I found a large lacerated wound of the right cheek, which freely communicated with the mouth, and extended from the zygoma to the symphysis of the jaw. The lower jaw was fractured transversely just below its neck, and the ramus considerably comminuted as far as its angle. Several of the teeth had been removed, while the tongue was but slightly wounded. The inferior dental nerve was exposed for an inch or more in its course, and presented a ragged appearance. Hemorrhage had been quite profuse, but was arrested by Dr. Jay, who, fortunately, was in the vicinity at the time of the accident. The patient had suffered from severe shock, but reaction was being established when I reached him. Several fragments of bone which were displaced and attached by a mere thread of periosteum required to be removed; this was done with as little disturbance of the periosteum as possible, and the exposed and torn portion of inferior dental nerve removed close to its emergence from the bone. The other portions of the wound were carefully cleaned, and the wound communicating with the mouth was approximated by strips of adhesive plaster, and dressed with picked lint, wet in a solution of carbolic acid and glycerin (1 to 20). Under the care of Drs. John C. Jay and Lounsberry everything progressed favourably, and the next time I saw the patient was in my office, Oct. 11th. The wound of the cheek had all closed save a small opening which communicated with the mouth, and readily allowed the passage of a probe, and through which some saliva was flowing. There was considerable consolidation of the jaw at this time, and the patient could open his mouth for the space of an inch; though when this was done, or when he laughed, the jaw would deviate to the left of the median line. Fearing that unpleasant contraction of the soft parts would result if remedial measures were not now employed, and the jaw appearing sufficiently firm, I ordered that the mouth be frequently opened as wide as possible, and he begin to take solid food, chewing upon the left side, he having up to this period been living upon fluids; at the same time the soft parts on the affected side be frequently stretched by the introduction of the finger into the mouth. Had not this plan been pursued I fear that the fracture which had occurred in the vicinity of the temporo-maxillary articulation would have led to anchylosis, whereas, by this line of practice, we were enabled to secure a false joint just below the point where the ramus joins the neck.

His next visit was on Oct. 21st, when I found that he had gained considerably as to the movement of the jaw. A small piece of detached bone was at this time removed from the direction of the symphysis. He complained considerably of saliva escaping from the wound on the cheek while eating. Application of the nitrate of silver was at this time made to the fistula.

From this date he progressed very favourably in every respect, there being greater freedom in the mobility of the jaw and less trouble from the saliva flowing down the cheek. When, on the 29th of Nov., I was called to see him, he informed me that he thought he had taken cold a few days before, and was suffering from a swelling just behind the lobe of the ear. There being evidence of suppuration at this point, it was opened, and the cause of the trouble found to depend upon a piece of necrosed bone, which was removed, and from this he recovered in a few days. Nitrate of silver was again applied to the fistula, which, however, seemed to give but slight annoyance.

The flow of saliva from the fistula, however, eventually increased, and

University of Michigan

became a source of great trouble, and, when I saw him again in Sept. 1871, there were now two openings from which saliva trickled and produced some excoriation of the face. These openings were but a few lines apart, and seemed to be a little below the site of Steno's duct, though the location was close to the spot where the duct enters the mouth—as was readily determined by a very fine probe which could be made to enter the canal from within the mouth. This probe could be only passed just within the orifice, where it met with obstruction. These fistulæ were situated in a tract of cicatricial tissue. His condition was now such that some radical steps were necessary for the relief of this distressing feature in the case, and he, as well as his friends, were anxious for something to be done to change the course of the saliva. In conversation at this time with Dr. James R. Wood, in reference to the treatment of this variety of fistula, he related two cases wherein he had been successful in cutting down upon the duct at the site of fistula and turning it into the mouth. In considering the various features of my case, I preferred this to the one of using the seton, so disagreeable had it proved in two cases where I had seen it employed in the hands of others. Another reason was, that I feared that the presence of the seton in this case, passing as it would have to through feeble cicatricial tissue, might lead to sloughing.

On the 24th of Feb. 1871, assisted by Dr. Jay, I proceeded to cut down upon Steno's duct, which fortunately was readily found by laying open the fistulous tracks, and, with a fine probe as a guide, I then dissected out the cicatricial tissue around the fistula, freed the extremity of the duct, and turned it in through an opening into the mouth. The external wound was then brought together by wire sutures. The upper portion of the wound healed at once very kindly, though at the lower portion there was some suppuration, and I feared the result of the operation, as, on the fourth day, a drop or two of what I took to be saliva tinged with blood trickled from the lower portion of the wound. Suppuration, however, soon ceased, and the wound healed, leaving my patient free from salivary fistula.

At the time of the operation I did not know that I was putting in practice the means suggested and adopted by Langenbeck in the treatment of these fistulæ.

Where this operation is feasible, I think it is one that commends itself to the favourable attention of the surgeon, though in many cases no doubt a more simple form of procedure may obtain a cure. I have never had the opportunity of again testing this method, but should not hesitate to do so in a case where sufficient healthy duct could be obtained and where cicatricial tissue would militate against other methods, or, what I should prefer in some cases, the cutting out of the fistula by means of a punch, and closing the external wound by suture, as suggested by the late Dr. Horner; which, to my mind, is a better method than by seton, being devoid of its disagreeable features. I am well aware, both from the literature of this subject and personal experience, that very many cases of fistula of the parotid or its duct that come under our care as the result of wounds, may be induced to heal by the use of such simple methods as the application of the hot wire or the nitrate of silver associated with compresses, and

in some instances by the introduction of probes through the canal; while some cases have healed spontaneously after a shorter or longer interval. The case of Col. Guiney, on page 330 of the *Surgical History of the War*, part first, is a striking example of the spontaneous closure of fistula of Steno's duct following gunshot wound, which took place one year after the receipt of injury.

In this connection the following case of fistula of the parotid gland resulting from a pistol-shot wound, recently under my care, is an example:—

W. D., aged 22, was admitted into Roosevelt Hospital Dec. 31, 1879, who, shortly before admission, received a pistol-shot wound in the right cheek, his assailant being about seven feet distant; the ball entering about one and a half inches behind and three-quarters of an inch above the angle of the mouth, passing in a direction backwards and slightly outwards to a point two inches behind and on a level with the lobe of the ear, at which site the ball was extracted. It passed through the masseter muscle, and, though grazing the bone, produced no fracture. A drainage-tube was introduced through the wound, and the parts syringed with a solution of carbolic acid. On January 4th saliva began to dribble from the posterior wound, though it also entered the mouth through its natural channel. The flow of saliva through the posterior wound was quite steady, and at times so profuse as to soak the dressings and trickle down the neck. The discharge began to abate on the 16th of the month, and on the 26th it had ceased, and the tube was entirely removed; the wound closed, and the patient was discharged, cured, Jan. 31.

During our late war it would appear (*Surgical History of the Rebellion*) that but few cases of salivary fistula were met with, though the records of wounds of the face are numerous; the methods adopted for their relief being those of occlusion, cauterization, and frequent dilatation of the excretory orifice of the canal of Steno. The reason of fistula not being more frequently met with after gunshot wounds was supposed to be due to the laceration produced by the projectile usually sufficing to obliterate the salivary ducts.

The variety of methods that have been put in practice for the cure of salivary fistula proves how difficult the management of some cases have been.

Cauterization, compression, and ligature of the duct for the purpose of causing atrophy of the gland, as proposed by Viborg, his experiments upon animals towards the close of the last century proving to him that there was no danger in the procedure, were among the earlier methods adopted.

Then follows the mode by seton, which has been varied greatly in its application. Either passed through the natural duct for the purpose of dilatation, or else passed through the mouth by means of a trocar through the fistulous opening, or through a perforation made by the hot iron or an awl; all these modes seeking to create a new channel for the saliva.

The idea of dilating the duct appears to belong to Morand and Louis,

who introduced a fine thread guided by a probe into the natural orifice of the duct, and withdrew it through the wound; this seton was gradually increased in size. When the saliva passed freely into the mouth, and when the ulcer had contracted to the periphery of the seton, the foreign body was then removed, the ulcer touched with astringents, and compress applied till it closed.

By the other method, when a communication with the mouth has been well established, and saliva flowing in the proper direction, the seton being withdrawn, the extended edges of the fistula are found and brought together by suture.

In place of the old method of dilating the duct by means of silk threads as practised by Morand and Louis, or by catgut and leaden wires maintained in the canal, as employed by others; the introduction of fine silver probes used at varying intervals has been substituted with pleasing success. Mr. Francis Mason, in his work on the "Surgery of the Face," cites an interesting case of cure brought about, by passing a probe through the mouth so as to emerge from the fistulous aperture in the cheek, then having bent the instrument slightly it was pushed along the duct as far as possible towards the gland. It was left in this position for the space of eight hours, and the operation again repeated after three days. After the first introduction of the probe, saliva ceased to flow from the opening in the cheek. In some cases we fear it might be no easy matter to pass a probe in this manner through the upper opening of the duct, though its prompt success in this case merits its further trial.

Mr. Pick, in the *Lancet*, for February 19, 1870, relates the following interesting case:—

> A girl 20 years of age was admitted into St. George's Hospital for a salivary fistula, which she had had from childhood, the result of abscess. It was a source of great annoyance from the constant dribbling of saliva. An attempt to pass a small probe down the canal to ascertain if an opening existed into the mouth was made. By using slight force he succeeded in passing the instrument a short distance, perhaps half an inch, but no further. On account of the size of the probe he abandoned the operation till a finer one could be procured. The following morning no saliva flowed from the fistula; her pillow, which formerly had been wet, was found dry; and she had lost the dryness of her mouth, from which she had greatly complained. She was under observation for a week or ten days, during which time she remained well.

Mr. Pick justly remarks that this case illustrates how recovery may sometimes take place in cases which at times are most intractable and difficult to cure. The result of this probing was no doubt sufficient to remove some obstacle, probably a small calculus which had prevented a spontaneous closure of the fistula, hence the rapidly effected cure.

As salivary fistula may arise from so many causes, and present various features and sources of location, be it situated in the course of Steno's duct, or of the ducts in the gland itself, or as it arises from sloughing the result of ptyalism, or follows gunshot or incised wounds, each case may

demand separate study and varied modes of procedure. Yet, from the remarks on treatment in most of our text-books on surgery, one might be led to believe that the seton was the only and all-sufficient method in dealing with these cases, many of which have been found quite intractable.

Perhaps of all the operations thus far resorted to, the one which would seem applicable to many cases, which is simple in its procedure, and devoid of the unpleasantness necessarily attached to the seton, is the one devised by our countryman, the late Dr. Wm. E. Horner, of Philadelphia. It not only proved successful in his hands, but in those of others. Dr. Henry H. Smith, in his work on "Operative Surgery," states he has operated by this method in two patients with perfect success, the external parts healing by the first intention.

The operation is thus described: The patient being seated, with the head well supported by an assistant, a strong broad wooden spatula is introduced within the cheek of the affected side; this is held firmly by the assistant. The wound being then slightly elongated by incising its sides in the line of the zygomaticus major muscle, a round punch, like that used by saddlers, should be placed over the fistulous orifice, care being taken to avoid the anterior edge of the masseter muscle. Then, on pressing the punch firmly against the spatula within the mouth, a piece of the entire thickness of the cheek will be removed, and a fresh opening made directly into the mouth. The external wound, being accurately closed by sutures and adhesive strips, will usually heal kindly, and the internal opening be found to give free vent to the saliva.

ARTICLE VI.

A CASE OF OVARIOTOMY IN WHICH PHLEGMASIA DOLENS FOLLOWED THE OPERATION. By WALTER F. ATLEE, M.D., of Philadelphia.

MRS. S. S., of Trenton, N. J., thirty-three years of age, medium size, rather healthy appearance, eight years married, never pregnant, always regularly menstruated, consulted me on account of abdominal enlargement, in February, 1880. This enlargement, the patient said, began six years before, in the lower part of the belly on the left side, and gradually increased, so that her general health was now seriously affected by interference with functions essentially vital, those of digestion, circulation, and respiration. She told me she had been under local treatment by electricity for a long time, having had over forty sittings. Her pulse was about 120. The belly measured forty-two inches in its greatest circumference; it seemed to project rather more on the left side than on the right. Fluctuation could not be felt through the whole mass, but it could undoubtedly be produced over the central portion.

This history and these particular symptoms, together with those com-

mon to all ovarian cysts, made me diagnose a multilocular ovarian cyst of the left side, and I advised its extirpation at an early day.

The patient came to this city on the 7th March to be operated upon, but was seized with her monthly sickness one week too soon, for the first time in her life. We waited until Wednesday the 17th to perform the operation. The sac had some adhesions to the omentum; one so firm that it was cut away, and the cut end was left in the incision when sewed up; the contents were *very* viscid, and *very* dark coloured, and there was but one sac;[1] the ovary diseased was the right one; the pedicle was very thick so that it was difficult to apply the clamp; the Fallopian tube adherent to it was so enlarged as to be taken for small intestine by one of the assistants. Some of the contents of the sac escaped into the cavity of the abdomen, and were allowed to remain for reasons not necessary to mention. The walls of the sac were very unusually thick, and the inner surface was covered with vegetations (papillary growths[2]) of all sizes up to that of a walnut. The patient did perfectly well; the clamp was removed on Sunday; the bowels were freely moved on Wednesday by injections, the patient being allowed to get up on the commode; on Thursday she sat up; on Friday she was allowed to walk a few steps. On Saturday, the 11th day of the operation, there was complaint of stiffness and pain in the left leg, which was quite swollen, and in the course of the crural vein was felt a hard cord. These symptoms diminished so that the patient was able to return to Trenton on the fifteenth day.

Dr. Bodine, her attending physician in Trenton, writes me under date of April 29th as follows: "Mrs. S. is doing very well. The wound in the abdomen has entirely healed, and her leg swells only a little during the day, the swelling passing off entirely during rest at night. As an explanation of the attack of phlebitis I would suggest that during the winter and spring in this region we have an unusual number of cases of various forms of erysipelas, cutaneous, cellular, and in the form of felons, and that the relations of erysipelas and phlebitis are very close."

This complication of the operation for the removal of an ovarian cyst I had never before seen or heard of. In the last number (for May) of the *Medical News and Abstract*, is reported, from the *British Medical Journal* of March 13th, a very interesting and very successful case of ovariotomy performed during the sixth month of pregnancy without interruption to gestation, and in this report we read that the patient did extremely well until the fifteenth day after the operation, when she was suddenly attacked by phlegmasia dolens of the left leg (and, as in my case, it was

[1] As said before, I had supposed the sac to be multilocular, because I could not cause fluctuation through it. The true reason of its not being caused, however, was that the force exerted by the hand in palpating through the thick coverings of the cyst, *and through the thick fluid*, was insufficient to set the fluid contents in motion.—See Guttman's *Handbook of Physical Diagnosis*, Syd. Society's Trans., p. 338–9.

[2] Dr. Joseph G. Richardson, to whom the growth was sent, says: "Thin sections from the nodule you gave me, from the inner surface of the wall of your ovarian tumour, show it to be made up of interlaced and convoluted compound papillæ covered with small columnar epithelial cells. Histologically these growths closely resemble papillomata and cylindro-cellular epitheliomata, but clinically they are distinguished from the latter by absence of any marked tendency to constitutional infection."

the right ovary that was removed), accompanied by induration in the course of the femoral vessels from the groin to the popliteal space. The patient improved gradually, so as to have very good health during the last month of pregnancy. Dr. Galabin, of Guy's Hospital, who was the operator in this case, says:—

"It is difficult to trace a direct causation for the phlegmasia dolens by which my patient was attacked fifteen days after the operation. If there had been any access of septic material, notwithstanding the carbolic spray, she would not have progressed so favourably for fourteen days after so severe an operation; and if the starting-point were inflammation near the pedicle, set up by the presence of the ligatures, it might have been expected that the right leg, and not the left, would have been affected."

Of course, in my case the presence of ligatures is to be left out of consideration altogether, in looking for the causes of the inflammation of the vein, and I am quite inclined to believe that the trouble did come from septic, or more properly, from *irritating* material, and see no reason whatever to doubt this from the fact that the cases did well for some ten days or two weeks. The irritating material was, I believe, the peculiar fluid in the sac, which in both cases had the same characters, and some of which, as before said in my case, got access to and remained in the abdominal cavity. Dr. Galabin says of this fluid that "it was not pale, but was stained by blood pigment to a deep reddish-brown," and "that the whole interior of the cyst was covered by papillary growth." The cysts and their contents had the same characters in these two cases, and I would attribute the extraordinary complication that attended them both, to the influence of the fluid that certainly escaped into the cavity of the abdomen in one case, and that may have done so in the other.

ARTICLE VII.

ON THE PHYSIOLOGICAL PATHOLOGY OF THE BLOOD.

By THOMAS WHARTON JONES, F.R.S., F.R.C.S., Professor of Ophthalmic Medicine and Surgery in University College, London; Ophthalmic Surgeon to the Hospital, etc.

IN a communication to the *Lancet*, two or three years ago, I showed that the process by which arrestment of bleeding from divided vessels in the bat's wing or frog's foot spontaneously takes place, as observed in detail under the microscope, is substantially similar to the process in the case of larger vessels of larger animals as explained by Dr. J. F. D. Jones,[1] in the beginning of this century. I pointed out, as Dr. Jones had done before, how cessation of bleeding is, in the first instance, owing to the

[1] On the Process of Nature in Suppressing Hemorrhage from Divided and Punctured Arteries, London, 1805.

mouths of the divided vessels becoming stopped up with clots of blood, and that this is favoured by the retracted and constricted condition which the mouths of those vessels themselves assume.

Coagulation of the blood, though in some respects a moribund manifestation, thus serves here an important preservative purpose, and may be appropriately accepted as constituting the first great point calling for consideration in a discussion of the physiological pathology of the blood.

The blood, as observed under the microscope, circulating within the vessels of the web of a bat's wing or frog's foot, for example, is seen to consist of the liquid plasma and the corpuscles—red and colourless—suspended in it.

The coagulation, which the blood undergoes after it has been drawn from the living body, is owing to a precipitation from the plasma of the stringy substance, named fibrin. This substance, according to the chemical doctrine at present prevailing, does not pre-exist as such dissolved in the plasma of living blood, but results from the combination of two different albuminous substances contained in solution in that fluid, namely *fibrinogen* and *fibrinoplastic*. The combination of these two substances to form solid fibrin, after the blood has been drawn from the living body, is supposed to be brought about by the agency of a ferment which is alleged to be derived from the contents of the colourless corpuscles of the blood set free by the bursting of those cells. Colourless corpuscles, however, do not really burst, though they collapse and undergo changes of shape by shooting out their wall in processes like the fingers of a glove. Their contents, therefore, are not evacuated.[1] And if a ferment, causing the combination of fibrinogen and fibrinoplastic to form fibrin, be generated in the blood, after being drawn from the body, it must be derived from some other source.

The fibres of the fibrin of coagulated blood are interwoven like a felt-work, in the interstices of which the corpuscles and serum are inclosed; but by and by the serum, which is the residue of the plasma, oozes out by the shrinking of the fibrin, whilst the corpusles are retained.

[1] See the descriptions and delineations of this in my Papers on the "Blood-corpuscle" throughout the Animal Series in the *Philosophical Transactions* for 1846. Here, I describe two forms of colourless corpuscles, which I designate respectively, the granule cell in the coarsely granular stage and the granule cell in the finely granular stage. Both kinds are seen to undergo change of shape after the blood is drawn from the body, but the latter in a more remarkable degree than the former. Thus, in the blood of the frog, I remark at page 67 that the granule cell, coarsely granular stage, exhibits change of shape with movements of the contained granules similar to what we see in the corresponding cell of the skate's blood, though not in so pronounced a degree; but the granule cell, finely granular stage, rapidly undergoes a more marked change of form by collapse and shooting out finger-like processes. This looks at first like a bursting of the cell and evacuation of its contents, but that it is no such thing can be easily proved by insinuating a minute quantity of water under the covering scale of glass, whereupon the collapsed, though apparently burst, cell becomes distended and is seen to be still entire.

All this is well known, but for a correct conception of the intimate nature of coagulation, the form-changes which the histological elements of the blood undergo in the process, require to be studied microscopically. The examinations for this purpose are best made on newly drawn human blood; but preliminary to this, we must make ourselves acquainted with the microscopical characters of the histological elements as they appear in blood flowing within the vessels of a living animal.

For such observations, the web of the bat's wing or frog's hind foot is the part which admits of being most conveniently displayed under the microscope, so that the correlations of the stream of blood in the arteries, capillaries, and veins may be watched for a lengti. of time and truly traced without the interference of such disturbance of the natural course of the blood as is necessarily occasioned when an internal organ—the mesentery,[1] for example—is drawn out and made the object of examination.

Here I beg to refer to Plate IV. in my Essay on the State of the Blood and the Bloodvessels in Inflammation in *Guy's Hospital Reports* for October, 1850, in which the appearance of the blood stream is represented in an artery, in capillaries, and in a vein of the frog's web. I beg to refer also to the Plate illustrating my paper on the Rhythmical Contractility of the Veins of the Bat's Wing in the *Philosophical Transactions* for 1852, in which the appearance of the blood stream is represented in arteries and veins.

The stream of blood in the artery appears pale red, and homogeneous in the axis where the red corpuscles keep together, colourless next the walls of the vessel, when there is nothing but plasma and a few colourless corpuscles, perhaps, in it, rolling or sliding sluggishly along.

In the capillaries, in which the flow of blood is slower, the red corpuscles are seen to pass along in single file overlapping each other. Colourless corpuscles occur here and there interrupting the series of red corpuscles or, without interrupting it, press it aside, as may be seen in both bat and frog.

The stream of blood in the veins being comparatively slower than in the artery, not only the colorless but also the red corpuscles may be individually distinguished; the former in greater or less number next the walls of the vein, the latter in the axis of the stream.

In the bat, when the flow of blood is much retarded, the red corpuscles may be seen to aggregate in rouleaux, both in capillaries and in venous radicles. Of this I have drawings made from the life before me.

In viewing the flow of blood in the venous trunks of the bat's wing, it is an interesting spectacle to watch the backward eddy of the blood corpuscles in the sinuses of the valves, when, during the systole of the rhyth-

[1] The mesentery of the frog, it is to be remembered, contains no capillaries. Small branches, recurrent from the arteries proceeding to the intestine, open directly into veins returning therefrom, as I originally pointed out.

mically contractile walls of those vessels, the valves are thrown into action to prevent regurgitation.

A colourless corpuscle may sometimes be seen adhering by a point to the wall of a vessel, and to be by the force of the stream, bearing on it, pressed into a pear-shape, so that it presents the appearance of a minute polypus attached by a peduncle. When sticking by a greater extent of surface, the corpuscle is seen pressed into the shape of a rain-drop on the window. (See the wood-cuts at page 14 of my Essay on the State of the Blood and the Bloodvessels in Inflammation, before cited.) The adhesion to the wall of the vessel giving way, as it is seen to do, the colourless corpuscle, thus set free, immediately resumes its globular form, and is carried along in the stream.

It is particularly to be observed that the change of shape which a colourless corpuscle sticking by a point to the wall of the vessel may be seen thus to undergo by pressure on it from without, has nothing in common, and must not be confounded with the intrinsic changes of form which the colourless corpuscles in blood newly drawn from the body are seen to exhibit, as a moribund action, from an inherent endowment of their substance, under the influence of the altered conditions in which they are placed. *Within the living vessels, colourless corpuscles never undergo any such metamorphoses.* To this I have to add, that I never saw colourless corpuscles escape from the vessels by boring through their walls or in any other manner.

The more or less stellate form, which colourless corpuscles in blood out of the body (the granule cell, finely granular stage, especially) usually assume, would obviously not be well adapted for boring through the wall of a vessel or pushing its way in the interstices of a tissue. (Refer to my Papers on the Blood Corpuscle throughout the Animal Series, before cited.)

On the surface of the frog's mesentery, numerous white corpuscles belonging to the peritoneal fluid are found. Some of these under the stimulating influence of the exposure to the air, I have seen shooting out a single process, and executing slight locomotive changes besides.

Whenever and wherever, in a much inflamed part of the web of a frog, I have seen corpuscles—white or red or both—free, the walls of the vessels in which they had been contained had already given way and disappeared, as described at page 51 of my Essay on the State of the Blood and the Bloodvessels in Inflammation, before referred to. In the cases in which there was no longer a distinct vascular coat to be seen, the boundary of the channel along which the blood continued to flow was composed of colourless corpuscles, unchanged in shape, accumulated like stones on the sides of a torrent which had subsided after an overflow.

Inflammatory congestion, in a spot, is seen to take place by the close aggregation of the red blood corpuscles, intermingled with colourless ones, blocking up the vessels, while the plasma, being thereby excluded, drains away in the stream. This aggregation of blood corpuscles, which may be seen in the bat (see my Paper in the *Medico-Chirurgical Transactions* for 1853, on the State of the Blood and the Bloodvessels in Inflammation of the Web of the Bat's Wing), as well as in the frog, ends in stagnation of the current. Notwithstanding this, the force of the blood from behind does not appear to bear heavily on the stagnant mass, but the stream glides gently off by the collateral branches of the artery above. The only indication of pressure is the oscillation of the blood in the vessel below the place, where the stream passes off, as in the case of a divided artery.

In the case of a divided artery, it is to be observed that it is at the further margin of the wound where the congestion is greatest. This is owing to regurgitation in the vessels to which the collateral branches of the divided artery lead; direct *vis a tergo* bearing but little on the blood in the vessels in the nearer side of the wound. It was long ago pointed out by Dr. Jones in regard to the current in large arteries, to which a ligature had been applied, that "the blood does not continue to be impelled against the extremity of the artery with the same impetuosity with which it flowed through the vessel before it was tied. The blood is immediately determined into the collateral branches above."

Apparently, under the erroneous impression that as much *vis a tergo* as before ought to bear on the blood stagnant in the vessels of an inflamed spot by the stream of blood in the artery or arteries leading to it, the same distinguished authorities who tell us that colourless corpuscles bore through the wall of vessels, allege as a *fact* that the red corpuscles may be seen to be squeezed out through the walls of the gorged vessels.

The reality, of what seems to be here referred to, is described in my Essay on the State of the Blood and the Bloodvessels in *Guy's Hospital Reports* for October, 1850, before cited, at page 49, under the head of Resolution of Inflammation, as follows: The agglomerated and stagnant mass of blood-corpuscles in the extreme arterial branches, the capillaries, and venous radicles, exposed to the force from behind in the artery leading to those vessels, is seen to oscillate, yielding a little at each stroke of the heart, and again recoiling. The agglomerated mass being at last pushed onwards a little, some of it protrudes into the free vessels (into which the congested ones have an outlet), the stream in which detaches and carries away the corpuscles. In this manner successive portions of the agglomerated mass are carried away until, at last, being reduced to a small bulk, it is all driven onward by the stream from behind into the stream in front, where it is broken up into its constituent corpuscles which are carried away.

This process of resolution of inflammatory congestion is acce'erated

when the artery leading to the affected spot becomes dilated so that more *vis a tergo* is permitted to bear on the stagnant blood. A demonstration of this phenomenon can be easily made, as I state in my essay so often cited, by applying some irritating drop, such as a weak solution of sulphate of copper with a little vinum opii, to a congested web of a frog, whereupon the artery, after being constricted a little, soon becomes dilated and the process of resolution proceeds. This fact I have over and over again adduced as an interesting illustration of the *modus operandi* of stimulating collyria applied to the conjunctiva for the cure of pustular and catarrhal ophthalmia.[1]

Having thus described the blood as it is seen within the small vessels of the living bat and frog, we have next to examine it when newly drawn. For this purpose we can make use of human blood; and here I may observe that as human blood is similar to bat's blood out of the body, except that the corpuscles of the latter are smaller, there can be little doubt that the blood within the vessels of the human body comports itself in all essential respects in a manner similar to what we have seen in the case of bat's blood.

I have before me three drawings of a small drop of human blood, as viewed under the microscope with an eighth of an inch objective and second eyepiece, which I made with special care. The blood, being placed on a slide, was covered with a thin scale of glass and forthwith observed. In the first figure the blood is represented as it appeared on being immediately examined. The corpuscles, both the numerous red and the few colourless, dispersed confusedly about in the plasma whilst the colourless were already beginning to collapse and shoot out processes. In the second figure the same portion of blood is represented as seen when examined in about a minute or two after being first displayed under the microscope. The red corpuscles have became aggregated together like coins in rouleaux; the colourless corpuscles scattered about free from any adhesion to the red corpuscles, and though more changed in form still entire—none of them burst. In the interspaces between the rouleaux of the red corpuscles, there were perceived on careful adjustment of the microscope fine, pale, colourless fibres, shooting in every direction close on the surface of the glass slide.

The transition from the state of matters represented in the first figure to that represented in the second takes place as follows: the red corpuscles first overlap each other in linear series, then rising up on edge become

[1] I have also over and over again indicated constriction of small arteries as the first step to the establishment of congestion in the capillaries and venous radicles to which they lead, but ignorance of the correlations of the flow of blood in the extreme arteries, capillaries, and venous radicles, has stepped in to prevent a comprehension of the process.

fully applied to each other, face to face. The rolls of red corpuscles thus formed are disposed section-wise and represent an irregular network. The colourless corpuscles remain dispersed here and there in the meshes of this network.

The fine, pale, colourless fibres which make their appearance on the glass slide soon after the aggregation of the red corpuscles into rouleaux are the fibres of fibrine which has been deposited from the plasma. The fluid that now remains in the interspaces between the rouleaux of red corpuscles is, therefore, serum only.

It is thus not until the red corpuscles have aggregated into rolls that the deposition of fibrin takes place.

The colourless corpuscles, though collapsed, have not burst, and therefore have not given out their contents. They were still the same in number after the fibrin had been deposited as before. The rapidity and closeness with which the aggregation of red corpuscles into rolls takes place is much promoted, as we shall see, by the quantity in the plasma of the albuminous materials which by their combination form the solid fibrin. After the fibrin has been deposited from the plasma, therefore, and nothing but serum remains, the red corpuscles cease to adhere tenaciously to each other so that the rolls into which they had aggregated tend to become broken up. This may be demonstrated by gently touching the superjacent scale of glass with the point of a needle. In consequence of the agitation thereby occasioned, currents of serum and loose corpuscles take place, but it is at the same time observed that many of the red corpuscles being glued by a single point to the glass slide through the medium of the deposited fibrin are, as represented in the third figure which I have before me, pressed into a pear shape by the force of the currents of serum and loose corpuscles bearing on them.

The arrangement of the rolls of red corpuscles in a network is exhibited *sectionwise* when the drop of blood is thinly spread out as above described. When, however, the blood in the form of a drop is examined under the microscope with a lower but good penetrating power, the rolls into which the red corpuscles become aggregated are observed to be disposed in every direction in the form of a *spongework*, in the interstices of which the plasma is contained. The fibrin next consolidating forms the feltwork, in the interstices of which are inclosed the rolls of red corpuscles now become more or less disrupted while the serum is gradually squeezed out.

Coagulation usually begins in three or four minutes after the blood is drawn, and is completed within ten minutes. Though, in a cupful of blood newly drawn by venesection, the red corpuscles by virtue of their greater specific gravity tend to subside, their complete subsidence is arrested by the deposit of the fibrin which entangles them in its meshes. Thus it is that the clot remains red at the surface as well as at the bottom.

In the blood drawn in certain states of the system—inflammatory states especially—a subsidence of red corpuscles takes place before coagulation commences, leaving the plasma collected at the top.[1] This is owing not to the plasma coagulating more slowly, but to the more rapid sinking of the red corpuscles. In such a case, plasma while still fluid may be skimmed off in some quantity with a spoon.

If a drop of fluid plasma thus obtained be transferred to a slide and thinly spread out by being covered with a scale of glass and examined under the microscope, colourless corpuscles in considerable number will be seen. The colourless corpuscles thus do not sink with the red ones, but remain suspended in the plasma. Here, again, we can clearly perceive that, however much they may change shape, they do not burst, and that the pale delicate fibres of fibrin we see by and by deposited on the glass slide (now in greater quantity than was seen in the examination of a drop of entire blood) are not derived from them either bodily or by any action of their alleged evacuated contents on the plasma as a ferment determining the combination of fibrinogen and fibrinoplastic to form the fibrin fibres.

Turning to the examination of the remainder of the plasma which was skimmed off and left to itself, we find it coagulated into a buff coloured or grayish jelly-like mass, from which serum, after a while, may be observed to separate as from ordinary coagulated blood. In this clot, we have a mass of fibrin unmixed with red corpuscles, but in which there are interspersed numerous colourless corpuscles. The fibres of this fibrin examined under the microscope, it is not difficult to identify with the pale delicate fibres which, as above shown, we observe making their appearance, by deposition on the glass slide from the fluid plasma.

The collection of plasma at the top in consequence of the rapid sinking of the red corpuscles in blood drawn in certain abnormal states of the system constitutes the condition on which the formation of the "buffy coat" depends; the buffy coat being simply the plasma with the colourless corpuscles which remained collected at the top, after the subsidence of the red corpuscles, now become coagulated.

The sinking of the red corpuscles in the plasma of blood drawn in acute inflammation used to be supposed owing to slower coagulation than natural; but the fact is that coagulation of such blood occurs often more rapidly. Moreover the subsidence of the red corpuscles in the plasma to

[1] This occurs normally in the blood of the horse, and affords a good opportunity of obtaining a drop of the plasma for microscopical examination, in order to find among the colourless corpuscles, examples of the reddish nucleated cell which I describe and delineate (in my Papers on the "Blood-corpuscle," above cited) in the blood of the horse and elephant. Here I ought to refer to Mr. Gulliver's beautiful experiments, showing that the sinking of the red corpuscles proceeds with accelerated rapidity in a sort of arithmetical ratio.

a degree sufficient for the formation of a buffy coat is found to have already taken place long before the time when blood normally coagulates after abstraction. The explanation of the more rapid subsidence of the red corpuscles is this: The disposition of the red corpuscles to aggregate together in rouleaux is very much augmented in blood on which a buffy coat is about to form. So much so is this the case in respect to rapidity that with whatever haste the drop of blood can be placed for examination under the microscope, the red corpuscles are found to have already aggregated; whilst in respect to closeness of aggregation, it is very much greater than usual. The effect of this increased rapidity and closeness of aggregation is that, being quickly collected together in compact masses, the red corpuscles sink in the plasma long before coagulation takes place. Again, it has been found that the condition of the blood which determines this more rapid and close aggregation of the red corpuscles is a more viscid and plastic state of the plasma arising from an increase in it of the quantity of the albuminous substances which combine to form the fibrin. The number of red corpuscles is at the same time less than normal.[1]

In some inflammatory states of the system the plastic condition of the blood is increased though not to so great a degree as to lead to complete subsidence of the red corpuscles before coagulation. In such a case, though there is no actual buffy coat, there is a large quantity of fibrin at the top of the coagulated mass which by shrinking causes excavation of the surface, a condition of the clot designated simple cupping.

In reference to the separation of the red corpuscles from the plasma, it is to be remarked that it does not appear to be exclusively a separation by mere subsidence of the former any more than the retention of the colourless corpuscles at the top depends on their mere swimming in the plasma. Whilst the red corpuscles have an attraction for each other, the colourless are attracted by the plasma. This we observed indicated in the blood, as before mentioned, while circulating in the vessels of the bat's wing or in those of the frog's web, by the tendency of the red corpuscles to keep together in the axis of the stream, whilst in the stratum of plasma adjacent to the walls of the vessels, there may often be seen accumulations of colourless corpuscles, but no red ones.

Within the vessels in the living animal—both bat and frog—the red corpuscles not only keep together but tend to aggregate into rouleaux when the blood flows slowly or becomes altogether stagnant.

In regard to the colourless corpuscles, they tend, as we have seen, to collect on the inside of the walls of the vessels, where the stream of blood is slow, but this depends partly on an adhesion between them and the walls of the vessels.

[1] See my various observations on the formation of the "Buffy Coat" in the *British and Foreign Medical Review* for October, 1842, the *Edinburgh Medical and Surgical Journal* for October, 1843, and *Guy's Hospital Reports* for October, 1850.

Colourless corpuscles, as before said, never undergo any amœba-like change of form within the vessels, but no sooner is blood drawn from the living body and examined under the microscope than such a change is found to have already commenced. But this change of shape, let it be repeated, is unaccompanied by bursting of the cell. After coagulation of the fibrin has taken place and the colourless corpuscles are now surrounded by serum alone, they tend by endosmotic absorption of the thinner fluid into their interior to resume a round form.

To recur to the mode in which coagulation of the blood contributes to the stopping up of the mouths of divided vessels and thereby to the arrestment of hemorrhage: The blood coagulating as it escapes, the clot which is formed in and around the retracted and constricted mouth of the bleeding artery is retained more firmly in its place by the interlacement of the fibres of the fibrin with those of the surrounding cellular tissue.

The condition on which the stoppage of bleeding from an artery depends, namely, retraction and constriction of its mouth, the more speedy coagulation of the arterial blood, and the greater firmness of the clot which is formed, are commensurate with the force to be resisted. If in the case of veins those conditions operate in a much less degree, so also is the force of the current to be stemmed very much less.

On the state of the blood o' the body generally at the time of the infliction of a wound dividing vessels, whether there be a sufficiency or deficiency of fibrinous materials, the formation of an external clot of sufficient firmness to arrest the bleeding greatly depends.

When bleeding from an artery is arrested by the formation of an external clot or by the application of a ligature, the stream of blood passes off, as before mentioned, by the first considerable branch above. Between this branch and the mouth of the vessel which is stopped up with the external clot or secured by the ligature, the artery is filled with blood. This collection of blood which presented itself as a glomerulus of red corpuscles next the mouth of the vessels, but higher up, is seen to consist chiefly of plasma with colourless corpuscles suspended in it, Dr. Jones called the *internal clot*. Petit had long before, under the idea that it was as operative in the suppression of the hemorrhage as the external clot, called it *bouchon*, whilst the external clot itself he called *couvercle*. Dr. Jones, however, showed that the internal clot plays no part in the arrestment of the bleeding, its formation being dependent on that event.

What Dr. Jones called the middle clot is of a different nature from either the external or internal clot, being composed of *exuded lymph*. The walls of the artery at the place of division, or at the place of ligature, becoming inflamed, this lymph is exuded and penetrates between the external and internal clots, or where the bleeding has been arrested by ligature, between the latter and the internal clot.

It is by the middle or lymph clot alone that the divided or ligatured artery becomes permanently closed, as was demonstrated by Dr. Jones. In the case of microscopical arteries, we see in the web of the frog that there is no special middle clot exactly, but the lymph exuded into the wound constitutes the material for the closure of the mouth of the vessel, as well as for the healing of the wound of the web.

Eventually the part of the artery occupied by the internal clot, and through which blood no longer flows, degenerates into a cord of cellular tissue, like what takes place in the case of the *ductus arteriosus*, *ductus venosus*, and the *umbilical arteries*, when the stream of blood is diverted from them.

A slough of the web of a frog having become detached, the network of vessels at the margin of the living part comes to present all the characters of a capillary network. The larger vessels, which have been truncated by the separation of the slough, become obliterated as far up as their connection with some considerable branch above, which now comes to represent the continuation, as the case may be, of the artery or principal radicle of the vein.

In microscopical examinations of frogs in which there existed sloughing and ulceration from inflammation excited by previous injury, I have often seen suddenly appear, in an artery of the sound web, glomeruli of red corpuscles, followed by loose flakes of fibrin holding together colourless corpuscles. Such glomeruli and flakes would perhaps block up the vessel for an instant or two, and then be forced on by the stream from behind, but to be succeeded by others. This appearance—of which I have drawings in my note-book before me—resembled somewhat the appearance within the caudal vein of the eel, of successive drops of red blood separated by the drops of lymph propelled into that vessel by the lymph heart.[1]

The embola referred to seem to be so many internal clots formed in the manner before described in connection with local congestions and stagnations, now become free in the general circulation, and similar, I believe, in their nature to the embola which are liable to occur in the human body after operations. They may block up any artery; but becoming at length diminished in bulk by successive disintegrations, as I have seen in the frog, they may eventually cease to cause any further obstruction. When, however, they happen to accumulate in and block up the pulmonary artery, death may be occasioned, as Sir J. Fayrer has found to be often the case after operations in India.

Sometimes I have seen only a grayish granulous plug consisting of colourless corpuscles held together by a tenacious looking fibrinous substance. A similar plug may be produced *at will* in the bat as well as in the frog,

[1] See my Paper entitled "The Caudal Heart of the Eel, a Lymphatic Heart," in the Philosophical Transactions for 1868.

by pressing pretty firmly with a blunt point over an artery or vein under microscopical observation.

The separation of the red corpuscles from the plasma, and consequently the formation of the fibrinous clots found in the heart and vessels after death, depend on the state of the blood before death in a manner similar to that which obtains in the formation of the buffy coat. Thus, in the bodies of persons who had died of pneumonia, inflammation of serous membranes, etc., in which the quantity of fibrinous material in the blood is increased and the disposition of the red corpuscles to aggregate consequently greater, the clots formed in the heart and large vessels were found by Rokitansky numerous, compact, and free from red corpuscles. Again, in cases in which, though there was no inflammatory alteration of the blood before death, the red corpuscles have been found to occupy the lower part of the clot corresponding with the most depending part of the body as it lay after death, so that here the separation had taken place by mere subsidence, in consequence of the greater slowness with which the blood coagulated within the vessels.

ARTICLE VIII.

GASTRO-HYSTERECTOMY, OR THE RECENT MODIFICATION OF THE CÆSAREAN SECTION BY DR. PORRO.

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I SELECT the word Hysterectomy as it expresses the true meaning of the act, the ablation or the removal of the uterus and ovaries, after the Cæsarean section is performed. Hysterotomy simply implies an incision without removal.

The medical profession are under many obligations to Dr. R. P. Harris, of Philadelphia, for his very valuable papers on the Cæsarean section, especially the last two, published in the *Americal Journal of the Medical Sciences*, for January and April, 1880. No writer has given more time, unwearied investigation, and closer attention to this important subject, and his information has been derived from various sources, not only in America and the British Isles, but also Continental Europe.

From his last two papers we glean that it is an absolute necessity, if the operation is to be successful, it must be attempted or resorted to as early as possible, or as early as the nature and circumstances of the case will admit, not only for the benefit and welfare of the mother, but of the child. Dr. Thomas Radford was a strong advocate for an early performance of the operation. It is however to Dr. Harris's untiring zeal, and to his able

exposition of statistical information, that we are indebted for the conclusive proof that it should be performed early.

"If," he says, "we persist in the delay of the last ten years, it will make but very little difference what operation is performed, there must be a frightful mortality. To think of twenty-six deaths in thirty-two operations, is a sad reflection, but the result is not to be wondered at, when twenty-four of the women were not operated upon till it was too late to have any but the faintest hope of success except in a few instances, these labours lasting from one day to two weeks, and a large number being two, three, or four days under this fruitless and exhausting process. Early cases tell the story of the last decade's failure."

The deduction from these remarks of Dr. Harris exemplifies how truly and decidedly they affirm and corroborate the true obstetrical law as recognized by the profession.—That in any case of natural labour which continues over twenty-four hours, the unfavourable results will be to the mother as one to six deaths, and for the child as one to four.

If nature pressing on to twenty-four hours shows such an unfavourable issue, what must be expected from any kind of instrumental delivery, or the Cæsarean section, either by the older method, or the recent modification, or laparo-elytrotomy?

The true and best test of these capital procedures is the result in cases in which the operation is performed early, and the correct appreciation from the statistical information respecting the operation should be from cases of that nature; unfavourable or almost moribund cases when the operation is resorted to should be excluded from the statistics.

The last report of Dr. Harris on the Porro operation shows that up to that time, April, 1880, there had been thirty-six cases operated upon, of which one-half were saved and one-half died. By rejecting or excluding those cases which were unfavourable owing to labour having existed for a long while, or through an exhausted condition of the system, the proportion would be materially changed, and would be as eighteen to eleven, nearly sixty-two per cent. saved.

In his article "On the Porro Modification of the Cæsarean Section in Continental Europe" (*American Journal of the Medical Sciences*, April, 1880), Dr. Harris descants on the valuable and original physiological experiments of Blundell in 1823 on rabbits recently delivered, and where the uterus was extirpated in four instances, three of these were successful and the fourth died. From these experiments Blundell presents the question to the profession: When the Cæsarean operation is performed, or when a patient is evidently sinking after a rupture of the uterus, might not the whole uterus be taken away? The physiological experiments of Prof. Porro in 1874, on the gravid uteri of rabbits, were made fifty years after those of Blundell, and the first practical illustration on record on the human subject was by Prof. H. R. Storer, of Boston, on Mrs. H., for fibro-cystic tumour of the uterus, complicated with pregnancy, and published in the *Gynæcological Journal of Boston*, by Dr. G. H. Bixby, October, 1869.

In his article Dr. Harris puts the question to the American medical pro-

fession, "Shall we adopt the Porro method of operating in the United States?" As many members of the profession may not be acquainted with the origin, the nature, and the manner of the operation as performed by Prof. Porro, of Pavia, Italy, a reference to his operation may add some interest to the subject under consideration, especially as the uterus had been extirpated before by Dr. Storer. Dr. Storer's claims appear to have been set aside or ignored by some of the Continental operators. Dr. Welponer, of Vienna, and Dr. Wasseige, of Liege, Belgium, consider the operation to have been purely an accidental one, arising from the nature of the case—a large fibro-cystic tumour blocking up the pelvic cavity, and admitting a space of only one and a half inches for the delivery of the woman. "We exclude," says Wasseige, "from the statistics the case of Storer, because the extirpation of the uterus was done with another object." The reasons assigned by Dr. Storer were the following:—

1st. That with the mechanical interference by the tumour the escape of the fœtus per vias naturales was utterly impossible.

2d. That the space of less than one and a half inches would not admit of either craniotomy, cephalotripsy, or cranioclasm, or any other mechanical interference per vaginam.

3d. That Cæsarean section in accordance with the views of all authors was clearly indicated as the only result; provided it were possible to remove the tumour by abdominal section.

After gastrotomy, the fibro-cystic tumour was opened, and found in a state of considerable degeneration.

The hemorrhage being already very profuse from opening the tumour, as Dr. Bixby says, and the danger from shock and exhaustion being imminent, Dr. Storer extended his incision into the cavity of the uterus, and with all expedition removed the child and the placenta, which was also in a state of decomposition.

There was little time to be lost, for the hemorrhage was perfectly frightful from the incision into the muscular structure of the uterus, together with the other vessels at the site of the placenta, and it was evident that the irregular contraction of the uterus could not staunch. Accordingly a large-sized trocar was passed through the upper segment of the cervix uteri, and a metallic cord passed doubled through its canula, the whole was firmly tied in two parts. Fearing that this might not be secure, the chain écraseur was applied, and the mass slowly removed. Dr. Storer's clamp was then used. The external wound was closed by ten metallic sutures. The patient died in sixty-eight hours after.

The removal of the uterus in this case was attempted in consequence of the tremendous hemorrhage owing to the exceedingly vascular structure involved, and which would not apply in many, if any, of the simple uncomplicated cases of pregnancy. It was therefore on the part of Storer an ulterior object, and not an original intention of the operator. I have intentionally presented the particulars of Storer's case, so that a just and correct opinion may be formed respecting the true nature of it. Dr. Storer nevertheless did perform the first operation for the extirpation of the pregnant uterus. Storer's case was unsuccessful, as might be reasonably expected, but it was done to save the woman as the last hope. It is

possible, therefore, that this formidable operation would from that instance alone, never have been recorded as one for adoption, or advocated as a modification of the Cæsarean section.

The operation of Prof. Porro was in this manner:—

"A dwarf, a primipara 25 years of age, four feet nine inches high, entered the obstetrical wards of the Hospital of the University of Pavia. She suffered severely with rickets when a child, and her pelvis became very much deformed. May 21, 1876, was taken in labour. Waters broke with the first pains, and after their continuance for six hours and forty minutes the Cæsarean operation was performed by Dr. Porro, and a living child removed.

"The uterus contracted, but not sufficiently to close the sinuses in the incised portion, and much blood was escaping from one edge of the wound. No effort in any way was made to arrest the hemorrhage, to enable the organ to contract, or to close the womb by sutures. The operator at once decided to extirpate the uterus, which he did with a strong wire and serre-nœud, placing the loop around the cervix opposite the inner os, and then tightening it. He then cut away the uterus by the scissors, passed a long drainage tube through Douglas's cul-de-sac, brought the cut cervix to the abdominal wound, and closed the abdominal incision with wire sutures.

"The operation commenced at 4.49 P. M; operation, nineteen minutes; sewing up, seven minutes; medication, eight; operation proper, twenty-six minutes."

Prof. Porro's operation proved successful, and the credit of having performed the first successful case of gastro-hysterectomy in a parturient women, without any complication, belongs to Porro. Had the patient of Porro died, as Storer's did, it is possible, independent of the valuable experiments on rabbits, and suggestions of Blundell in 1823, and of Porro in 1874, and others, the profession would, probably, never have heard any more of the new modification of the Cæsarean section, and we would not at the present time, but for the successful issue of Porro's case, be considering its advantages over the old style.

Since the publication of his paper, in the April number of the *American Journal of the Medical Sciences*, which includes only 36 cases, in a letter dated April 22, Dr. Harris informs me that he has increased the European list by 12 more cases, making, with the two American cases (Storer and Taylor) the whole number, at this time, 50 cases, of which forty-nine were operated upon in the last four years.

The 50 operations are divided as follows:—

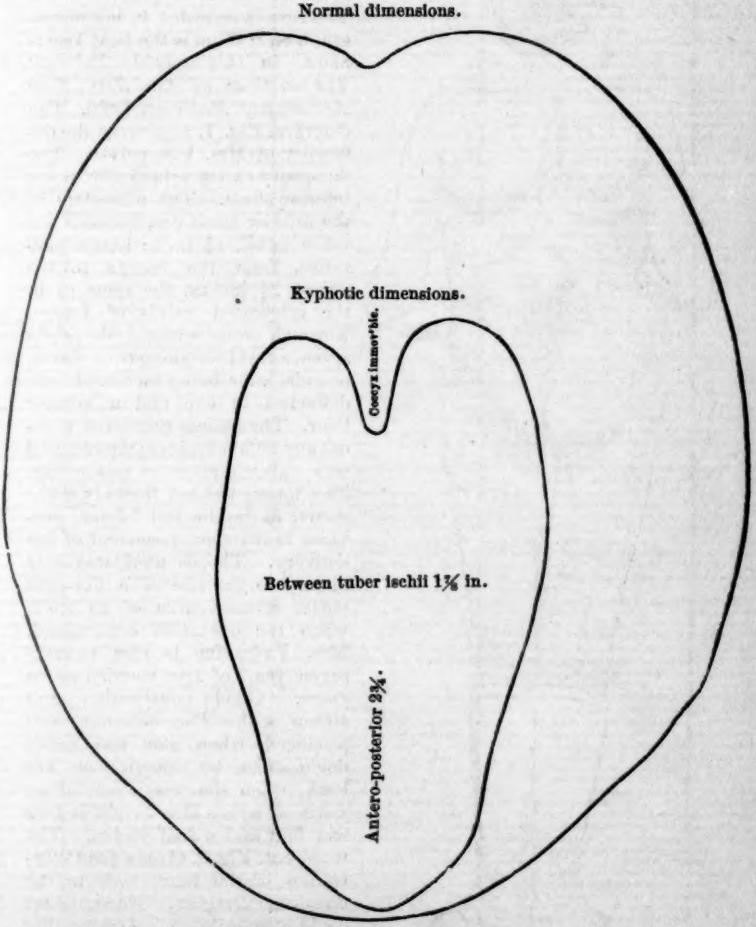
United States	2	Operations.	0(?1)	Women	saved.
Italy	23	"	8	"	"
Austria	11	"	6	"	"
France	7	"	4	"	"
Germany	4	"	0	"	"
Belgium	2	"	1	"	"
Switzerland	1	"	1	"	"
Total	50	"	20(?21)	"	"

Austria may possibly be entitled to 7 cures. No operations in Russia.

In marked, and I may say, very favourable contrast to these, we have the statement of Prof. Chiara that out of 62 operations, old style, performe

by Porro, Billi, Lazzati, and himself, all had proved fatal but three (3), which were saved by Billi out of his 37 cases. The balance, 25, under Porro, Lazzati, and himself, were all fatal; the proportion being as 1 woman saved to 21. The recent modification giving the proportion as 1 to $2\frac{1}{3}$, and this in continental Europe, where there are so many cases of deformities presenting themselves. The success, therefore, of the new departure is remarkable and very great.

Fig. 1.



Kyphotic pelvis (outlet) of Mrs. V.

CASE.—In the early part of December, 1879, Mrs. Vallentine called on me and stated that she was four and a half months advanced in pregnancy, and that she had decided with her husband and her mother that she wished to have a living child; that she did not desire to undergo the former kind of operation, and have the child sacrificed. I had operated on Mrs. V. March 5, 1875, performing craniotomy, cephalotripsy, and cranioclasm, in the presence of a number of professional friends. Mrs. V. has a Kyphotic pelvis. The case is recorded in my monograph on "What is the Best Treatment in Contracted Pelves." *Transactions of the New York Academy of Medicine*, 1876. The diagram, Fig. 1, represents the deformity of Mrs. V.'s pelvis. The deformity exists principally in the inferior strait. The diameters in the inferior strait are, between the tuber ischii, 1⅞ inch; antero-posterior, from the coccyx to the pubes, 2¼ inches, the same as in the celebrated pelvis of Lange. Through this diminished pelvic space, a child weighing over eleven pounds, after being sacrificed, was delivered in one and a quarter hour. The patient recovered without any unfavourable symptom, and was walking about in two weeks. The labour existed for only a few hours, as in the last labour, previous to the commencement of her delivery. The os uteri was only opened to the size of a five-cent piece, seven-eighths of an inch, when the operation commenced. Mrs. Vallentine is now twenty-seven years of age, married seven years. Good constitution and strong will. The deformity was produced when she was going down stairs, by tumbling on her back, when she was nearly three years of age. Her height is four feet four and a half inches. The wood-cut, Fig. 2, gives a good illustration of the hump-back in the dorso-sacral region. No argument could change her mind respecting any kind of operation I might select; she wished a living child.

Fig. 2.

If it will not be considered as irrelevant at this time, but to show her determination and will and nerve, just as she was going to step on the table she handed me a small slip of paper, on which was written, "Doctor, I have no more change." January, 1880. I invited my colleagues of the Maternity Hospital, Drs. Lusk, Pallen, Gillette, and Mundé, to examine her at my residence. After the examination they thought it a favourable case for operation, and for laparo-elytrotomy. My own views were not decided at that time, whether I should select gastro-hysterectomy or laparo-elytrotomy.

From the favourable report of Dr. S. Possi respecting the operation of M. Pean, whom I saw operate in 1873, for fibroid tumour of the uterus, I learned that he had saved 17 out of 24 cases from 1869 to 1875. Later still I read the reports of the uncommonly successful cases of Dr. Thomas Savage, of Manchester, in 1878 and 1879, saving 5 out of 6, when the pedicle was dropped inside the pelvis; and the case of Dr. Gillette, successful to the mother, operated upon by laparo-elytrotomy, published in the *American Journal of Obstetrics*, January, 1880. Dr. G. considered "that for the operation the armamentarium of the obstetrician must be increased beyond his scalpel, sound, ligatures, and blunt hook, independent of version, the forceps, perforator, cephalotribe, and cranioclast," which were all used in his case. All these facts induced me to adopt the recent modification by Porro, of the Cæsarean section, as giving my patient, as well as the child, a more favourable chance for living.

I waived all consideration of any more danger from the operation than from the operations for fibroid tumours of the uterus, and the removal of the uterus, or for any of the other abdominal operations for various diseases or circumstances. But, still further, I considered what would be the pedicle of the uterus, the isthmus or intermediate part which exists between the body of the uterus and the cervix proper, as being more eligible for an operation for the extirpation of the uterus, at the full term of pregnancy, than in the non-pregnant state of the uterine structure, consequent on the physiological changes incident to pregnancy.

There are two modifications presented for acceptance to the profession to which I propose offering another, the one I performed.

1st. The Porro method—

1. Abdominal incision.
2. Opening the uterus, delivering child and placenta.
3. Ligating the uterus by the serre-nœud and removing it.
4. Securing pedicle by clamp to the abdominal wound.
5. Drainage tubes through Douglas's space.

2d. Müller, of Berne:—

1. Abdominal incision of seven and a half to eight inches.
2. Turning out the uterus.
3. Ligating it by the serre-nœud or écraseur.

4. Opening the uterus and delivering child and placenta.
5. Securing pedicle or stump to the abdominal wound.
6. Drainage tubes through Douglas's space.

3d. Taylor, of New York:—

1. Abdominal incision, four and a half to five inches.
2. Opening the uterus and delivering child only.
3. Ligating the pedicle with strong whip-cord or fish-line, as a temporary ligature.
4. Cobbler stitch one inch below for permanent ligature.
5. Removing uterus with placenta by scissors or scalpel.
6. Dropping pedicle in the pelvic cavity; no drainage tubes.

It was my intention to have operated a few days previously, so that I could avail myself of the daylight. Mrs. V., however, on the evening of the 7th April, had incipient uterine pains. Early on the morning of the 8th labor had commenced. Pains at intervals of three-quarters of an hour. No dilatation of the cervix uteri. Cephalic presentation. Auscultation gave no evidence of the placenta being over the anterior part of the uterus, but it was recognized in the right lateral region of the uterus. 3 P. M. was selected as the time for the operation.

At 2½ P. M. pains every 20 minutes. Vaginal examination as before, and not the slightest dilatation of the cervix. Bowels had been moved, and the bladder evacuated.

At 3 P. M. Present Drs. Lusk, T. Burchart, H. Deblois, J. M. Hills, C. Cleaveland, F. Dennis, F. A. Burrall, C. A. Leale, W. Wells, of New Rochelle, Gillette, Mundé, and several others who came in later. The Listerean method was adopted, not only in the dressing, but the spray was used before, during, and after the operation. All the instruments, sponges, ligatures were carbolized.

The line of incision was through the linea alba. The abdominal structures were very thin. There was no hemorrhage, and the length of incision was four and a half to five inches. The anterior part of the uterus at once came into view, presenting a very vascular appearance, of a deep purple colour. The uterine sinuses were noticed coursing through its structure, large and full, and evidently betokened that a part of the placenta was lying underneath in the line of incision. Free bleeding followed the first gentle touch of the knife in the peritoneum of the uterus. The incision was made through the muscular structure, which was not more than one-third of an inch thick, and one inch long. The finger introduced recognized at once the placenta. The uterus was then quickly divided by the scissors up to the fundus, and downwards to within one and a half inch of the bladder. The hand was immediately carried through the partial placental attachment, the right groin of the child seized and safely delivered, and the child—a large one—cried instantly. The cord was tied by Dr. Dennis. Dr. Lusk was requested to elevate the uterus and tilt it forwards, while I cast a strong fish line around the base of the body of the uterus, and tied it as a temporary ligature three-quarters to one inch below the muscular structure of the body. The placenta was allowed to remain in utero. Immediately a double carbolized, strong Chinese silk ligature was passed an inch below the upper ligature with the strong curved needle I am in the habit of using in cases of lacerated

perineum. The ligature was then tied very tight, and, as I thought, made secure enough. I had decided, previously to operating, to use the cobbler stitch, but the pedicle appearing so much smaller than I expected, I rested confident at the time on its availability, allowing even for some retraction to occur. I was, however, mistaken; after the retraction, the spermatic artery on the left side I found was bleeding, as well as the utero-ovarian artery running through the broad ligament. In a short time the cobbler's suture was inserted through the superior part of the broad ligament, as well as through the pedicle of the uterus, and the hemorrhage was arrested at once. No blood or liquor amnii escaped into the pelvic cavity, and it was left perfectly clean and dry. The abdominal wound was closed by carbolized silk sutures and dressed *a la Lister*.

The hemorrhage when the uterus was first incised, as it was very vascular, welled up quite freely, and to some may have appeared considerable, but it bore no comparison to the excessive and gushing stream in her first confinement, after the placenta had been cast off. Dr. Dennis, who carefully watched the pulse, informed me that at the close of the operation her pulse was as favourable as could be expected after the quick delivery of the child as well as the removal of the uterus, although it was considered as full during the operation. The shock, if there was any, would be attributed to this circumstance.

The time of operation was, as recorded by Dr. W. Wells, of New Rochelle: First incision at 3.20 P. M. Uterus opened at 3.25 P. M.—5 minutes. Child delivered at 3.27 P. M.—7 minutes. And uterus ligated and removed at 3.30 P. M.—10 minutes for operation. Finished operation entirely at 4.20 P. M.—1 hour.

Two hours afterwards the record was, pulse, 120; respiration, 30; temperature, 99¾°. At 10 P. M., pulse, 112; respiration, 26; temp., 99¾°. At 10 P. M., second night, pulse, 108; resp., 22; temp., 100¼°. It is not necessary to continue this minute detail, which was regularly kept until the sixth day. Only on the fifth day the temperature was 101¼°; pulse, 99; resp., 18.

The treatment was chiefly milk and lime water, in small quantities, for four or five days; hypodermic injection of Maj. sol. morph. five drops, according to circumstances. She generally slept very well and naturally, and every morning, when asked how she felt, responded, "Very well—splendid; I want something to eat." As the kidneys were acting very freely, the urine was drawn every three or four hours, unless she was asleep. The object in evacuating the bladder so often was to prevent its becoming so distended as, by stretching of its peritoneal covering, to drag upon the pedicle. On the sixth day the abdominal sutures were removed, and everything presented a favourable aspect. A few hours afterwards I recognized that the lower part of the external wound was not perfectly closed for one and a half inch. Two sutures were introduced, and the wound was completely closed by the 30th of April.

On the seventeenth day phlegmasia dolens commenced in the calf of the right leg, and on the twenty-first day it was beginning to subside. It was a mild attack, but on that day the left leg showed slight symptoms. Both limbs had materially improved by the treatment on the 2d of May, so as to exclude any danger from the disease itself. There was no fever, no increase of pulse or temperature during the duration of the phlegmasia, nor at any time after the operation. The treatment was ammon. carb. and tinct. ferri mur. Limbs swathed in soft flannel. She had been taking

for some time iron and quinia. She improved so much from the phlegmasia dolens, and as the wound was perfectly healed, and no other symptom existing to claim attention, patient feeling remarkably well, as she herself said, except the limb, that on Sunday, May 2, I was considering about dismissing her, and only visiting her occasionally. She expressed a strong desire to get up and be moved on to the couch. I learned that she had previously, on the 15th, been up for a short time. I insisted very decidedly that she was not to rise or move herself about the bed, informing her of the great danger now that she was convalescing from the phlegmasia, greater than when it commenced. I did not visit her on Monday. That morning, while her husband was absent, she was lifted from her bed by the nurse, whom she had changed, and by her own assistance she got up, and sat in the rocking-chair for some time. Her husband returned home at 4 P. M., at which time she had slight vomiting, was faint, restless, and had some dyspnœa. I was sent for at 4.30 P. M., visited her at 5.15, and at once recognized that my patient had cardiac thrombosis, and had but a short time to live. Her face was mottled; lips blue, nails, fingers, and toes the same; cold hands and feet; almost pulseless; and dyspnœa. She was conscious, and informed her husband and myself that she was dying. I remained one hour, and she died at 7.30 P. M., three hours from the commencement of the attack of embolon, and twenty-six days after operation.

I regret this denouement, but no case could present a more clear exposition of disobedience to the advice of a physician, and the penalty was death. This is the third instance of embolism I have seen in five or six weeks. One of my patients died of embolism of the pulmonary artery five weeks after confinement. In two cases, some few years since, both of my patients being self-willed, and thinking they were perfectly well, contrary to the advice given and urged not to move the limbs, died in twenty minutes. Mrs. V.'s sudden death, therefore, though it may have an indirect bearing on the case, cannot militate against the exceedingly favourable result of the operation, for there was not the least untoward or unfavourable symptom occurring during the whole convalescence, everything was so perfectly natural. The attack of phlegmasia dolens was a mild one, though fatal in its issue from disobedience.

The time for the performance of Porro's method is from thirty to forty-five minutes or one hour. Müller's operation requires from one and a half to two hours, as in Liztman's case.

An objection has been entertained against this method, that it deprives the child of its natural supply of blood, and it has to be resuscitated after its removal from the uterus. The reasons I entertained for not resorting to the serre-nœud of Cintrat, or any of the different écraseurs, although I had prepared myself with them in case I should require their assistance, as well as for not using the clamp, and having the pedicle attached to the abdominal wound, were the following:—

Dr. Wasseige, of Liege, Brussels, in the report of his second case, says: "A chain écraseur was applied to constrict the cervix, but the tissues being

so very friable an artery was opened, and before it was secured there was a serious loss of blood." In Dr. Coggi's case: "The pedicle or stump had formed no adhesion with the abdominal wound, which was five and a half inches long, and was in part retracted within the abdominal cavity; a portion of the inferior angle of the wound being retained by a fragment of uterine tissue held in the handle of the serre-nœud. The autopsy showed a retraction into the pelvic cavity by a failure of union with the parietes, and that this was interfered with by the involuntary movements produced by the serre-nœud." In Prof. Chiara's first case: "In consequence of the effect of vomiting, the pedicle was drawn into the abdominal cavity, and a knuckle of bowel forced out. This gave a severe shock to the system, from which she did not rally. The patient was in good health at time of labour." In one of Blundell's experiments, the fourth, the rabbit died in consequence of the ligatures slipping from their places, which were in contact with the abdominal incision internally. But independent of these citations, and others might be made, I was influenced by the anatomical views I entertain respecting that part of the uterus which intervenes or exists between the muscular structure of the body of the uterus and the cervix uteri proper—the isthmus, a structure which is entirely different from the body, narrower and slender, yet having space sufficient, consequent on its capability of being stretched or lengthened, to admit of its being ligated and divided between the ligatures, and to drop the pedicle into the pelvic cavity, instead of having it attached to the abdominal wound, as is so frequently done in the case of the ovarian pedicle. There will and must be consequently less motion or disturbance given to the cervix uteri, from its central position in the pelvis, and it will avoid its being twisted on its own axis. If the pedicle is short it must inevitably drag upon its attachment or union to the abdomen, as we have seen in the cases referred to. The pedicle will necessarily be longer in some instances than others; after the union has become complete, with the external wound, it may in time become, if it was short, amply long enough by its stretching, as it was in Porro's case, to allow of free motion.

On examination of a case after several months it was found that it had become *one* inch long, so that the woman could run, walk, and jump without any abdominal pain. Now, neither the muscular structure nor the glandular cervix admit of such lengthening or stretching. As a further corroborative proof as to the part stretching, it has been demonstrated in the unimpregnated uterus, and after many months after delivery in a non-involution of that organ, and in some cases of procidentia uteri.

Let us examine now the illustration (Fig. 3) of the specimen of the ablated uterus immediately after its removal from Mrs. V. and the delivery of the child. It exhibited anatomical as well as physiological points of much value and considerable interest. I was not prepared, however, to witness as clear and decided demonstrations respecting the three differ-

ent kinds of structure belonging to that organ when in the pregnant state and when at the full term of pregnancy.

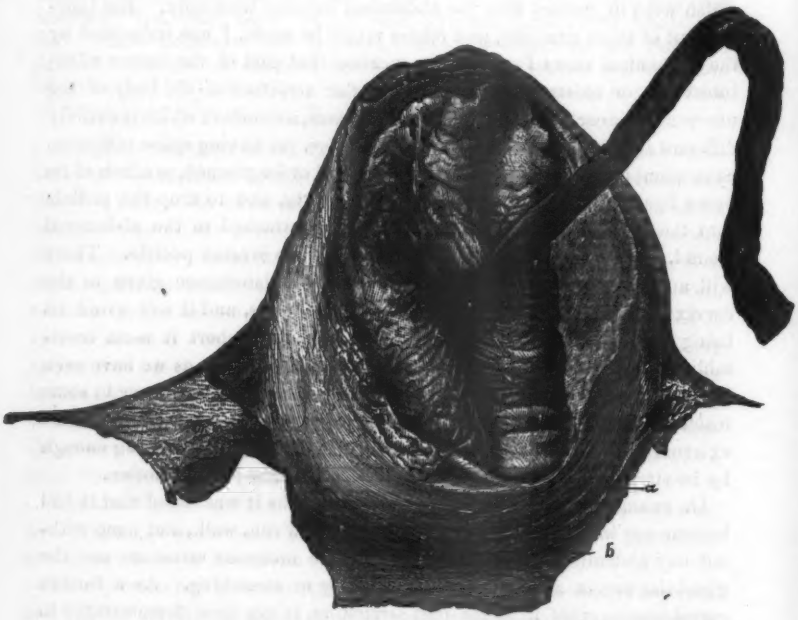
The specimen shows:—

1. The firm and true muscular element belonging to the body of the uterus solely, clearly, and distinctly.

2. The fibro-serous element existing between where the true muscular structure terminates and the cervix uteri, the isthmus or intermediate part, as this is the part which is constricted or ligated, and where extirpation is made, and may be two to two and a half inches long, and not the muscular structure; nor

3. The glandular structure, the cervix proper, which is left in the pelvis. The cervix was not dilated in the least.

Fig. 3.



a, body of uterus; *b*, pedicle.
Length of muscular stump, 9½ in.; breadth, 5½ in.; length of pedicle ¾ in.; breadth, 1¾ in.

No living specimen could demonstrate more positively the views which I have held and advocated for so many years, and it proves how erroneous the opinions and views of some obstetricians are, as well as are the late opinions of Bandl, of Vienna, respecting this intervening or intermediate portion of the uterus. Some of the operators have stated that it is the cervix uteri which is constricted, but that part remains after ablation, and

is intact if the operation is performed early and the cervix has undergone no expansion.

With this modification of the Cæsarean section the operation can be taken advantage of before or at the commencement of labour. The muscular structure will then have suffered no change from continued contraction. By the removal of the uterus it sets aside the fear that metritis or metro-peritonitis will take place. As there is no uterus, the blood and lochia are excluded from creating any peritonitis or septicæmia arising from their presence. Prof. Spath has informed us that it has aided, if not cured, his patient with osteo-malacia. Hemorrhage need not be feared.

Shock to the nervous system is incident to all capital operations, and I do not think there is or will be more to be feared from the removal of the uterus than from a large fibroid, or fibro-cystic, or any abdominal tumour.

Syncope, for various reasons consequent on any capital operation on the abdomen, may happen in the most favourable cases, as is witnessed sometimes in natural and easy cases of labor. I have witnessed two cases of syncope in one day in quick but short and sharp deliveries in delicate persons; the patients were supposed to be dying or dead.

I erred in the manner of ligating the pedicle, as my judgment was overruled by the appearance of the smallness and thinness of the pedicle which I had to deal with, as well as from its size, its structure and its breadth, as the specimen shows, not being more than one and three-quarters inch in diameter. I should have applied the cobbler's stitch or suture as I originally intended, and not rested secure on the double ligature, and I do not think there would then have been any retraction of the pedicle from the ligature, and the arteries, the spermatic and utero-ovarian, would not have become exposed so as to demand any further constriction. I have always attached considerable value to this suture under various surgical necessities demanding its application over the ordinary form of suture, since I first used it in 1864, and presented it for acceptance to the medical profession in my monograph on procidentia uteri—*Bellevue Hospital Reports*, 1869. Dr. Emmet adopted it in several of his ovariotomy cases, and by the number of times he has resorted to it acknowledges its value.

This is the first instance in this country of the avowed intention, after the Cæsarean section, of extirpating the uterus. It was, so far as the operation is concerned, perfectly successful, as it is generally thought that, if the woman is doing well on the sixth or eighth day, she is almost certain to recover. The phlegmasia dolens which occurred on the seventeenth day, and was slight, was in a great measure recovered from. The death of the patient was caused by her own imprudence in rising from her bed contrary to positive and emphatic advice, especially at the time of recovery from the phlegmasia, and not by anything relating to the operation. Why should the case not, therefore, be considered among the saved, after twenty-six days from the operation?

The method I adopted differed in some respects from the methods of the Continental operators. The unique specimens illustrate distinctly the great advantage, I believe, of this modification. I am therefore impressed with the belief that it will be far preferable, for the reason advanced, and the anatomical view I have presented, to treat the pedicle as I did, and not resort to the clamp and drainage-tubes. In Briesky's case the cervix, as he states, remained open for forty days, forming a fistula. Septicæmia may therefore evidently occur from the imperfectly closed vessels of the pedicle.

The operation of removing the uterus is, from the standpoints I have taken, simple and easy; in it there is as much of a pedicle to ligate and remove as in an operation for ovarian tumour, and it is as justifiable as the removal of any ovarian tumour. The pedicle is longer in some instances than in others, and is modified in structure according to the nature of the constitution of the female at the time of operation, thicker or thinner, denser or more friable. As to the ablation of the uterus, unsexing the woman, it does no more than the Battey operation for the removal of the ovaries in the unimpregnated state. The future beneficial result, nevertheless, is to the woman of incalculable advantage and benefit. It claims an interest in her behalf in not allowing her to have any more progeny. It abrogates her right, justly, and as I conceive morally it should, to undergo another capital operation. It is a boon to her, though she may not be aware of the loss of the womb. It is absolutely necessary in a social and political aspect; for women of that class who are deformed from disease, as is witnessed so often in Continental Europe, are not capable of giving that care and attention necessary for the sustenance of their children, who, as well as themselves, are more generally cast upon the public charities for support, and they virtually become therefore a lien on the finances of those charities. The operation may unsex the mothers so far as the loss of the uterine organs are involved, but it does not remove or extirpate the sensual enjoyment, as that remains as normal as ever. It is a moral obligation, I hold, therefore, of the highest duty to sacrifice that organ, as much so as it is held to be a high moral duty by some of the most eminent obstetricians, and none more so than by our celebrated Meigs, that the sacrificial act of the child should not be performed several times, and by some that not more than once in those cases of deformed pelves necessitating the performance of cranioclasm, but to relegate it to the performance of the Cæsarean section or the modification of that operation or laparo-elytrotomy.

A word or two as to why, in my own case, only one ovary was removed. This was owing to my not recognizing how much the uterus was leaning to the left side, and thus not being held in the central position, which prevented the left ovary from being included in the ligatures of the pedicle. One ovary remaining will not admit of the idea being entertained, which idea has been advanced, that pregnancy might occur again. To

entertain such an opinion at the present enlightened age, can only be construed into a visionary hypothesis.

The success of the recent modification of the Cæsarean Section by Prof. Porro is truly remarkable and very great. Only four years have elapsed, and there have been forty-nine operations; and in eleven years fifty, including Storer's. It has certainly instituted an entirely new order of events respecting the Cæsarean section, considered as it is by some as one of the most dangerous of all abdominal operations on the female. It is, however, a very singular circumstance, under the present aspect of the Cæsarean section, as to what kind of operation to perform, simple or modified that Prof. Blundell says: "If the Cæsarean operation be performed on a rabbit in the ordinary way, it will generally be found, unless I am much mistaken, that the *animal perishes in consequence.*" With his four experiments and removal of the uterus, three were successful out of the four. The modification by Porro of the "old style," thus far has diminished the death-rate very much. As I stated above, Prof. Chiara has shown by his last report, which I have quoted, that out of 62 cases lately performed, as before the new departure, only 3 were saved; which is as 1 saved to 21 deaths. By the modification, it has been demonstrated, as shown by the latest record of Dr. Harris, that out of 50 operations there were 20 saved—1 to $2\frac{1}{2}$; if the unfavourable cases are excluded nearly 75 per cent. This record on the human subject would seem to corroborate Blundell's experience on animals. Time will, I believe, prove it to be an immense advantage to the parturient woman suffering from these great deformities of the pelvis, and at this early day, only four years since the innovation, the prediction of Blundell has been verified, and his pronunciamento will be accepted as true, that it is "an eminent and valuable improvement in obstetrics."

ARTICLE IX.

THE RESULTS OF THE FIRST FIFTY CASES OF "CÆSAREAN OVARO-HYSTERECTOMY," 1869–1880. By ROBERT P. HARRIS, A.M., M.D., Philadelphia, Ex-President of the Philadelphia Obstetrical Society, etc.

AMONG the multiplicity of titles furnished me in letters and pamphlets from Europe, upon the Porro operation, I have seen no one as appropriate as the above, which is employed by Dr. Paolo Negri, of Milan. It is hardly just to Prof. Porro to call by his name all the forms of utero-ovarian ablation now practised as completive of the Cæsarean section. We are obliged to accept them all in estimating the mortality of the cases, but if we were to reject the experimental modifications we should find a better record for those strictly according to the design of the Pavian professor. One thing is certain—the associates of Dr. Porro have thus far

done the most successful work. He was present, on February 25th, at the sixth operation in Santa Caterina Hospital of Milan, and must have been gratified afterward to learn that the woman had recovered, making four saved in order out of the six, and also saving the six children. Milan now numbers 7 operations, and Turin 5, with 6 recoveries out of the 12. The balance of Italy, with 11 operations, furnishes but 2 recoveries, one of them being the case of Dr. Porro. There are good reasons for an excess of mortality in the balance; but all the cases were not managed as those of Milan and Turin. If the carbolic spray and Lister dressing are essentials of success, then some of the failures may be attributed to the want of them.

My remarks are not now confined to Europe, as in my last paper,[1] but apply to the seven countries, including our own, in which the operation has been performed. There have been, in all, 30 operators; one has operated 5 times; three, 4 times; one, 3 times; five, twice; and twenty, once. As I have had letters and pamphlets concerning thirty-six of the operations sent to me, I feel that the statistics have been carefully sought out.

Of the fifty cases twelve have not yet been published, and several others have simply been announced, so that the results are known through the journals. Some of the reports that have been sent me in full are known but very imperfectly, in the locality where the cases occurred. It is but four years since Porro performed his own operation, and already it is a very difficult matter to obtain reports of all the cases. Cases have been held back, and were only obtainable by perseverance and pressure. As a correspondent remarked, "If we have so much difficulty in obtaining the records of a recently introduced operation, and one of so much interest, what faith can we have in the statistics of a past age?" Whoever collects the second fifty operations will find it no simple matter to avoid omissions.

In the last number of this Journal I gave a table of 36 cases; the 14 to be now added are credited as follows: to Prof. Horatio R. Storer, Boston, 1869, 1; Dr. Girolamo Previtali, Bergamo, Italy, 1878–79–80, 3; Dr. Just Lucas-Championnière, Paris, 1879, 2, 1880, 1, = 3; Prof. Gætano Valtorta, Venice, 1880, 1; Dr. Guiseppe Chiarleoni, Milan, 1880, 1; Dr. Luigi Mangiagalli, Milan, 1880, 1; Prof. Gustav Braun, Vienna, 1880, 1; Prof. Alessandro Cuzzi, Modena, 1880, 1; Dr. Hausner, Barmen, Germany, 1880, 1; and Prof. Isaac E. Taylor, April 8, 1880, New York, 1. The cases that recovered were one of Championnière's, one of Mangiagalli's, and the second of Gustav Braun's. Eleven of the children were delivered alive; two of Championnière's died on the third and thirteenth days respectively.

Dr. Previtali has promised to report his four operations in the *Annali di Ostetricia*, of Milan. All the women were rachitic, and died of

[1] American Journal of the Medical Sciences, April, 1880.

exhaustion, the longest survival being only thirty-six hours; he saved two of the children. Previous to these operations he delivered nineteen cases by the old Cæsarean method, saving but two women, who were treated in the country. These, with the sixty-two of the same order obtained by letters from Milan, give eighty-one Cæsarean operations for Northern Italy, with only five recoveries.

Dr. Championnière's cases were, in La Maternité, two; Cochin, one; and Necker, one; and all operated upon in two months. His four cases were all rachitic dwarfs, measuring in height from three feet, seven and a half inches, to four feet, three and a half inches. The two which recovered were operated upon at full term and before labour fairly set in, one having as yet no pains, and the other slight ones. The operations were strictly performed according to the method of Porro. These give La Maternité a record of three operations, with two recoveries; more saved than in a hundred years by the old Cæsarean section.

Prof. Valtorta, of Venice, lost both mother and child. Dr. Chiarleoni operated on a rachitic subject of twenty-nine, in Santa Corona Hospital, Milan, on Feb. 17, 1880. The woman died of hemorrhage on the fourth day; the child was saved.

By a letter from Vienna, received May 17th, I am happy to announce that the case of Gustav Braun terminated favourably, both as to mother and child. This credits the "Krankenhaus" with nine operations, saving five women and nine children. The woman in this last case was rachitic, making three cases of malacosteon to six of rickets; two of each class died.

Prof. Cuzzi, formerly of Milan, and now in the Medical School of Modena, operated on March 2, 1880, on a rachitic subject who unfortunately was suffering with nephritis. The operation was performed when the os was opened to one centimetre in diameter. The woman died of peritonitis on the fourth day; the child lived. Dr. Hausner lost both woman and child, the former of hemorrhage on the third day from rupture of the ligature, the cervix being enlarged from inflammation and causing it to give way. The child was lost by prolapsus of the cord.

The Russian cases referred to in my last paper were erroneously reported in Paris. Dr. Oscar Prévôt's case was made the foundation of a rumor which has grown to be two Porro operations with one recovery. As my authority is Dr. Prévôt himself, who has kindly sent me a record of his operation, I can speak authoritatively. He operated in a case of rupture of the uterus, ten hours after the accident, and removed both it and the ovaries. The woman died on the fifth day from frequent hemorrhages of the pedicle. There was no pelvic deformity. The rupture took place in labour under the excitement of drunkenness; the uterus was sound in tissue apparently. The case attributed by Dr. Pinard to Dr. X., of Moscow, has had no foundation. Dr. Prévôt's operation is the first and only one of its kind on record.

Case 50 will be found fully reported in the current number of this Journal by Prof. Taylor; I will, therefore, only refer to it as a modification of the method of Porro, the design of the Pavian Professor being to avoid having the uterine wound within the abdominal cavity, by securing the stump of the cervix in the lower commissure of the abdominal incision. There have been six instances in which the operation of Dr. Porro has been modified, and four of the women died. No one in Europe had yet ventured to drop in the pedicle after a Cæsarean ablation. Dr. Taylor tried the experiment, and I regret very much that his patient finally perished. In the twenty-seven deaths occurring after the operation in Europe, there is no case of phlegmasia dolens mentioned, and only one woman died as late as the tenth, and one other as late as the ninth day; the death on the ninth day was from peritonitis, and on the tenth from tetanus. Dr. Taylor, in my opinion, incurred an additional risk in his departure from the Porro plan. In my former paper I spoke of the dangers of this proposed modification, and of the probability of *phlebitis*, metritis, etc. I do not say that the plan of Dr. Taylor may not succeed, but I do not believe that it will be found as safe to operate in this way upon the pregnant as upon the unimpregnated uterus. The successes of Péan, of Paris, had much to do with influencing the mind of Porro, but they did not induce him to drop in the ligated cervix. His theory, and that of Dr. Blundell, were based upon their comparative experiments on rabbits, and this led him to remove the uterus as the centre of danger, and convert the wound into one virtually out of the body, to be dressed as such, and kept under observation in case of hemorrhage. I believe that Dr. Taylor's patient would, in all probability, have recovered if he had dressed the cervical stump in the abdominal wound, transfixing it with strong pins, as has been done by Chiara of Milan. We cannot compare the pedicle in ovariotomy with the tied cervix in a case like Dr. Taylor's, and argue, from the successes in dropping in the former, that doing the same in the latter should bring a like result. Phlegmasia dolens is a very rare sequel of ovariotomy; is there reason to believe that it will be equally so after ligating the cervix uteri? But this is not the only reason why the pedicle in Porro's operation should be dressed externally. There are dangers of septic peritonitis, which must be greater with a wounded surface to discharge within the peritoneal cavity than external to it. It is much to be regretted that Dr. Taylor's modification, according to our view, increases the risk, as there are points which would otherwise make it a valuable improvement. The operation performed by him has already reflected unfavourably upon the Porro Cæsarean section, which his was not, in a vital point. If we want success in Cæsarean ovaro-hysterectomy, we must follow the examples of Milan, Turin, Vienna, and Paris, where the operators have saved 14 out of 27, or $51\frac{23}{27}$ per cent.

Chronological Register of the 50 Operations.

1.	Storer.	Boston.	1869.	Woman	lost.	Child dead.
2.	Porro.	Pavia.	1876.	"	saved.	" alive.
3.	Inzani.	Parma.	1877.	"	lost.	" "
4.	Hegar.	Freibourg, G.	"	"	"	" "
5.	Previtali.	Bergamo, I.	"	"	"	" dead.
6.	Späth.	Vienna.	"	"	saved.	" alive.
7.	"	"	"	"	lost.	" "
8.	C. Braun.	"	"	"	"	" "
9.	Chiara.	Milan.	"	"	"	" "
10.	Muller.	Berne.	1878.	"	saved.	" dead.
11.	Wasseige.	Liége.	"	"	"	" alive.
12.	Franzolini.	Udine, I.	"	"	lost.	" 2 "
13.	C. Braun.	Vienna.	"	"	saved.	" "
14.	Chiara.	Milan.	"	"	lost.	" "
15.	Tibone.	Turin.	"	"	"	" "
16.	Litzmann.	Kiel, G.	"	"	"	" "
17.	Breisky.	Prague.	"	"	saved.	" "
18.	Wasseige.	Liége.	"	"	lost.	" "
19.	Perolio.	Brescia.	"	"	saved.	" "
20.	Riedinger.	Brünn, A.	"	"	"	" "
21.	Fehling.	Stuttgart.	"	"	lost.	" "
22.	Chiara.	Milan.	"	"	saved.	" "
23.	G. Braun.	Vienna.	"	"	lost.	" "
24.	Previtali.	Bergamo.	"	"	"	" " [1]
25.	Tibone.	Turin.	1879.	"	saved.	" "
26.	Fochier.	Lyons.	"	"	"	" "
27.	Coggi.	Cremona, I.	"	"	lost.	" "
28.	Tarnier.	Paris.	"	"	"	" dead.
29.	Tibone.	Turin.	"	"	"	" alive.
30.	Peyretti.	"	"	"	"	" "
31.	Tarnier.	Paris.	"	"	saved.	" dead.
32.	C. Braun.	Vienna.	"	"	"	" alive.
33.	Previtali.	Bergamo.	"	"	lost.	" dead. [1]
34.	Berruti.	Turin.	"	"	saved.	" alive.
35.	C. Braun.	Vienna.	"	"	lost.	" "
36.	Mangiagalli.	Milan.	"	"	saved.	" "
37.	C. Braun.	Vienna.	"	"	"	" "
38.	Chiara.	Milan.	"	"	"	" "
39.	Championnière.	Paris.	"	"	"	" "
40.	"	"	"	"	lost.	" "
41.	"	"	"	"	saved.	" "
42.	Hausner.	Barmen, G.	1880.	"	lost.	" dead.
43.	Previtali.	Bergamo.	"	"	"	" alive. [1]
44.	Championnière.	Paris.	"	"	"	" "
45.	Valtorta.	Venice.	"	"	"	" dead.
46.	Chiarleoni.	Milan.	"	"	"	" alive.
47.	Mangiagalli.	"	"	"	saved.	" "
48.	G. Braun.	Vienna.	"	"	"	" "
49.	Cuzzi.	Modena.	"	"	lost.	" "
50.	Taylor.	New York.	"	"	"	" "

Annual Division of Cases.

1869.	Operations	1.	Women	saved	0.	Children	alive	0.
1876.	"	1.	"	"	1.	"	"	1.
1877.	"	7.	"	"	1.	"	"	6.
1878.	"	15.	"	"	7.	"	"	15.
1879.	"	17.	"	"	10.	"	"	14.
1880.	"	9.	"	"	2.	"	"	7.

[1] Previtali saved two of the children in his last three operations, I cannot say in which cases.

General Summary.

Italy	23 Operations.	8 Women saved.	21 Children alive.
Austria	11 "	7 " "	11 " "
France	7 "	4 " "	5 " "
Germany	4 "	0 " "	3 " "
United States	2 "	0 " "	1 " "
Belgium	2 "	1 " "	2 " "
Switzerland	1 "	1 " "	0 " "
	50	21	43

Causes of dystocia.—Deformed pelvis from rickets, 34; from kyphoscoliosis, 2; kyphosis, 1; malacosteon, 6; infantile pelvis, 1; Pelvic tumours, 3; operation in extremis from anasarca and dyspnœa, 1; cause not yet ascertained, 2 = 50.

Causes of death.—Peritonitis, 6; septic peritonitis, 5; septicæmia, 3; tetanus, 1; exhaustion, 4; shock, 2; broncho-pulmonary œdema, 1; anæmia and peritonitis, 2; hyperpyrexia and delirium, 2; hemorrhage, 2; and cardiac thrombosis, 1 = 29.

Noted as dwarfs, 30; hospital cases, 47; private patients, 3; percentage of women saved, 42. Of the first 50 classic Cæsarean operations in the United States, 23 were favourable to the women, or 46 per cent.; children extracted alive, 27. Whole record of the United States, 112 operations, with 48 recoveries, or 42⅞ per cent.

713 LOCUST ST., PHILADELPHIA, May 18, 1880.

ARTICLE X.

CONTRIBUTIONS TO THE STRUCTURE AND CLINICAL HISTORY OF THE MULTIPLE NEUROMA, FROM THE PATHOLOGICAL LABORATORY OF THE ALUMNI ASSOCIATION OF THE COLLEGE OF PHYSICIANS AND SURGEONS, NEW YORK CITY.

By T. MITCHELL PRUDDEN, M.D., of New York.

THE tumours of the nerves are either single or multiple, and when multiple, may either be confined to a single nerve trunk, or be found in nearly all the spinal and cranial nerves, in the brain and spinal cord, and in the sympathetic. It is convenient to apply the general term, multiple neuroma, to those cases in which a greater or less number of tumours exist on more than one of the main nerve trunks or their branches.

Although somewhat artificial, this classification is convenient as expressing, in a general way at least, the distinction which seems to exist between what appears to be a local, and a more or less general lesion. The recorded cases of multiple neuroma are so few, their clinical history so obscure, and the anatomical lesion in many cases so marked and extensive, and present features of such surpassing interest alike to the physiologist, the pathologist, and the practitioner, that a description of every case in which the

clinical history is known or new anatomical facts are elicited, seems in the highest degree desirable.

The purpose of this article is to record a new case of this rare disease, and to give a brief summary of the cases hitherto described.

For the following clinical history of the new case, the writer is indebted to the courtesy of Dr. Herbert W. Little, Resident Physician to the Presbyterian Hospital, New York City.

CASE I.—Maria D., female, age 25, single; lady's maid; Canada. Admitted to hospital Oct. 14, 1879. Family history negative. The uterine and associated functions have been normally performed; no venereal history. Seven years ago she had an attack of smallpox which lasted two months, and while convalescing she became partially paralyzed in both lower extremities, loosing sensation in both feet. The knees could be flexed with difficulty, and the thighs partly drawn up. Very little movement possible of the foot upon the leg. The upper extremities were unaffected, the arms and fingers being used for somewhat delicate manipulations, such as sewing and writing. She took strychnia for some time without benefit. Two months ago the use of electricity was commenced, and under it both feet recovered sensation, and the right leg recovered its power to a certain extent.

Before the use of electricity she had no pain, but since then she has experienced pain, sometimes quite intense aud of increasing severity along the course of the sciatic nerves. On admission, patient was fairly well nourished, but presented a marked anæmic, even cachectic appearance. Motion in legs comparatively limited. The higher senses are intact, and she possesses average intelligence. General cutaneous sensibility normal except in the right foot. Numerous tumours were found in different parts of the body, especially in the right iliac region, axillæ, and neck, which were not painful on pressure, and had been first noticed during her convalescence from smallpox, since which time they had gradually enlarged, but had given her no inconvenience and attracted little attention. Under tonics and the continuous current she improved somewhat, but was still harassed, especially at night, by dull aching, or sometimes darting pains, along the course of both sciatics. There were no abnormalities in respiration or cardiac action, nor had she ever experienced any convulsive movements. Examination of the blood revealed considerable increase in the relative number of the white blood cells. On Nov. 1st, when apparently doing well, she was suddenly attacked with nausea and vomiting, then with diarrhœa, and died in four days.

The usual brain and visceral examination was made on the day following death, and the subject finally found its way into the anatomical department of the College of Physicians, where further dissections were made. The writer wishes here to express his indebtedness to Dr. N. P. Warner for a report of the condition of the cranial nerves, and to Drs. T. E. Satterthwaite, Pathologist, and W. H. Porter, Curator, to the Presbyterian Hospital, for a report of the autopsy and for some of the abdominal tumours.

Autopsy, forty hours after death. Rigor mortis pronounced; panniculus adiposus abundant; subcutaneous tissue slightly œdematous. A large tumour in the right iliac fossa was felt through the abdominal walls, and series of larger and smaller tumours or masses of tumours were distinctly to be felt on both sides of the neck, in the axillæ, and extending down the

arms, and along the course of both sciatics down to the popliteal spaces. The heart presented no marked change. The lungs were slightly œdematous, and presented slight abnormalities in the form and number of the lobes. On the removal of the heart and lungs, a series of small whitish tumours was seen scattered at short intervals along either side of the spinal column; along the intercostal spaces the pleura was bulged out toward the thoracic cavity at irregular intervals, by numerous larger and smaller tumours lying between the ribs. The large tumour in the right iliac fossa, which weighed about two kilos, was embedded in, and attached to, the branches of the lumbar and sacral plexuses, and consisted of a congeries of larger and smaller tumours varying in size from a small pea to a goose egg, and the whole so firmly attached to the periosteum of the ilium that a portion of its superficial layers came off with the tumour on its removal. Within the mass of tumours a cyst was found containing about 150 c. c. of transparent straw-colored fluid. The whole mesentery was studded with small white tumours resembling enlarged lymphatic glands. On the anterior surface of the stomach was a white, sub-peritoneal tumour, about as large as a walnut. The stomach, intestines, liver, bladder, and generative organs presented no abnormalities. The kidneys were both deeply congested, and the capsule at some points slightly adherent. Microscopical examination showed a slight degree of parenchymatous inflammation. The brain and meninges were deeply congested, but otherwise presented nothing abnormal. The spinal cord was not examined at the autopsy, but the canal was opened later, and although the post-mortem changes were then too great to permit the formation of any opinion as to the ante-mortem condition of the cord itself, no tumours were found either upon the membranes or on the roots of the spinal nerves. The cauda equina was, unfortunately, not examined. One optic nerve presented a small fusiform enlargement just before piercing the sclerotic and numerous tumours of the same character were found on the supra- and infra-orbital, buccal, supra-maxillary, gustatory, and hypoglossal nerves, and also on the occipital, spinal accessory, and upper portion of the phrenics. Of all the cranial nerves, the lesion was most marked in the pneumogastrics, especially the right. The left pneumogastric in the cervical region was enlarged throughout and presented a series of distinct tumours; its average diameter being about 1 cm. The right pneumogastric (see Fig. 1) presented, near the point where the superior laryngeal is given off, a tumour 3.6 cm. in diameter and 6 cm. long. Between this point and the bifurcation of the trachea a series of tumours averaging about 2 cms. in diameter and 3 cm. in length, were closely set along the nerve, which was itself at no point less than 4 mm. in diameter. Below the tracheal bifurcation, the nerve as-

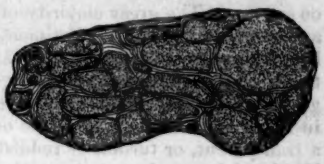
Fig. 1.

One-third the natural size.

sumed nearly its normal dimensions, but was for the most part involved, as were its œsophageal branches, in a series of fusiform tumours varying from 8 to 30 mm. in length and 4 to 16 mm. in thickness. The sympathetic of the right side was also the seat of excessive changes. (Fig. 1.) In the place of the superior cervical ganglion an oblong tumour was found 9 by 3.2 cm. In the deep cardiac plexus all the nerves were enlarged, as were the branches coming from the pneumogastric, and were thickly beset with irregular-shaped tumours from the size of a pin's head to that of a small Lima bean. The nerves of the extremities, which were fully examined only in the left leg and right arm, were thickened throughout almost their entire extent, and were the seat of the most extensive tumour formation. In the hand and foot alone the lesion was slight.

The tumours varied from the size of a pin's head to that of a hen's egg. The changes were more extensive in the lower than in the upper half of the body. Both sciatics, at their exit from the pelvis, presented themselves in the form of immense irregularly knobbed cords, the left, measuring at its upper portion 6 by 3 cm. in diameter, and diminishing but little in size down to the popliteal region. The right sciatic was somewhat larger. (Fig. 2.) At their upper portions, the external and internal popliteals were of nearly equal size, and measured about 4.5 by 3 cm. in diameter. All the nerves of the leg, both muscular and cutaneous, were thickened, and presented numerous ovoidal and fusiform tumours of varying size; the posterior tibial in the middle of the leg measured 2 by 1 cm. in diameter. Below the ankle-joint the nerves were but little thickened, and presented no distinct tumours. The left anterior crural, as it passed beneath Poupart's ligament, measured 3 by 1.5 cm. in diameter, and its muscular and cutaneous branches were thickly beset with tumours from the size of a millet seed to that of a large almond. On the main trunk of this nerve and its branches 276 distinct tumours were counted.

Fig. 2.



A transverse section of the right sciatic in the upper portion of the thigh. Natural size.

In many places, especially in the thighs, the subcutaneous tumours were so abundant as to form a dense mat, almost concealing the muscles beneath. On the left cervical plexus was a tumour as large as a hen's egg. All the nerves of the right arm as far down as the wrist were greatly changed, especially above the elbow. The right brachial plexus was formed of a mass of thick knobbed cords.

The whole number of distinct tumours counted in the right arm was 142. The whole number of tumours counted in the entire body, exclusive of the right leg below the middle of the thigh and the left arm, was 1182. All the muscles of the left leg between the knee and ankle were more or less yellow in colour, and this was most marked in those on the posterior aspect of the limb, where the gastrocnemius and soleus, although presenting their normal size and shape, were entirely converted into fat tissue. The right leg unfortunately was not examined.

In some cases the tumours present themselves in the form of more or less symmetrical usually fusiform enlargements of the nerve. In other cases a portion of the nerve is seen passing, without enlargement, over the surface of the tumour to which it is often closely bound by connective

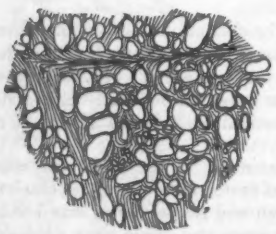
tissue. The tumours are all inclosed in a distinct capsule, sometimes loose and thin, sometimes dense and thick, which, in many cases, seems to be a direct continuation of the lamellar sheath and perifascicular connective tissue.[1] In some cases they are arranged along the nerves at irregular intervals like beads upon a string, in others they are crowded closely together, giving the nerve the appearance of a cylinder with more or less well-defined constrictions at irregular intervals. In the larger and more complex nerve trunks, such as the sciatics, the entire cord is surrounded by a distinct sheath, within which are contained congeries of tumours attached to the different groups of nerves, each in turn being inclosed by distinct connective tissue membranes of varying thickness which serve as partitions between the different tumours and nerve cords. These tumours are intimately joined by oblique and transverse nerve fascicles which running from one to another weave the whole together into a tolerably compact mass.

In no case was a tumour found to which, by careful dissection, a nerve fibre could not be found joined. Not less varied is the consistency of the different tumours, and the appearances which they present macroscopically on section. The great majority of the smaller and medium-sized tumours are soft and distinctly gelatinous, but all intermediate forms are seen between these and those which possess the consistency and general characters of the fibromata. The softer gelatinous tumours are either transparent, grayish, and crossed here and there by bands of more consistent tissue; or, in many cases they are of a pale or deep red colour and exude on pressure a transparent, or turbid, or reddish fluid. Occasionally very thick walled bloodvessels may be seen upon the cut surfaces.

The microscopical examination showed that in those parts in which the lesion presented itself in the simplest form, that is, in the simply hypertrophied nerves, the change consists essentially in a diffuse sclerosis of the intra-fascicular connective tissue, the new formed tissue being for the most part dense and firm and furnished with few cells.

This thickened intra-fascicular connective tissue is more firmly joined to the neurilemma of the nerve fibres than it is under normal conditions, so that by carefully brushing thin sections of the nerves under water, the medullary sheaths and axis cylinders may be entirely removed leaving a more or less dense consistent reticulum behind. (Fig. 3.)

Fig. 3.



Portion of such a pencilled section.

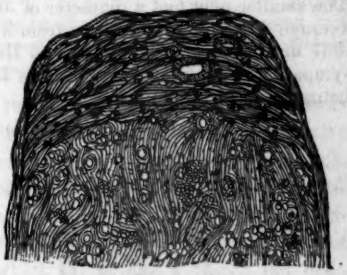
In those cases in which the nerves present small but more or less distinctly circumscribed enlargements, the above described diffuse sclerosis exists either in the entire, or, which is more commonly the case, in circumscribed portions of the nerve; but in addition to this, there is in many cases, a more or less uniform involvement of a part or all of the inner layers of the lamellar sheath. This change in the lamellar sheath may consist in a growth inward from it into the nerve, of broad or narrow branching fascicles of connective tissue dividing

[1] To avoid misconceptions, the writer would state here that in the following anatomical descriptions of the nerves he uses the nomenclature employed and in part suggested by Ranvier in his Leçons sur l'Histologie du Système Nerveux, vol. i. p. 179 et seq.

the latter into irregular areas or chambers: or, what is frequently the case, the inner layers of the sheath at one or other side of the nerve or in its entire circumference become either simply thickened, or spread apart by an accumulation of cells of various sizes and shapes or by new formed connective tissue, so as to occupy a considerable portion of the diameter of the enlarged nerve and to form the greater part of the tissue constituting the tumour proper.

In many cases, the lamellar sheath thus altered (see Fig. 4) is sharply outlined against the sclerosed nerve within, in others it passes without sharp demarcation into the tissue of the latter. In those cases in which a separation of the layers of the sheath occurs, the individual layers often retain their endothelial covering, as may be readily seen in transverse sections.

Fig. 4.



Part of a transverse section of such a small fusiform tumour, near the middle of which some of the nerve fibres are much compromised by the diffuse sclerosis. For the sake of clearness the medullary sheaths and axis cylinders have, except in one place, been left out of the drawing.

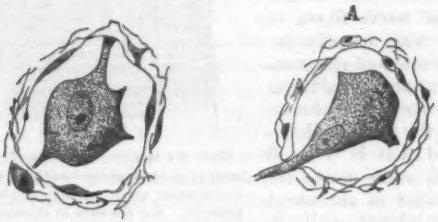
No attempt was made by counting, to determine whether the number of nerve fibres in the tumours was actually increased, but a series of measurements of a great number of fibres in the nerves leading to the tumours, and in the tumours themselves, showed that in a small proportion of cases only, the average diameter of the nerve fibres was diminished, while in the great majority of cases they preserved their normal diameters, and in some cases, particularly when the new formed tissue was soft and presented the characters of mucous tissue, many fibres were found which were considerably thicker than any found in the nerves leading to the tumour; a circumstance which seems to be of no little significance in view of the surprising absence of definite symptoms which is often seen it these cases of multiple neuroma.

The larger tumours presented for the most part the structure of the fibromata or the myxomata, or more frequently a combination of the two. In some of them the lamellar sheath was intimately involved in the tumour mass, in others it was simply stretched around it. With one exception (see below), no evidence was found of any increase in the nerve elements proper within the tumours. In those tumours, which were distinctly myxomatous, very numerous narrow fibres, singly or in clusters, with oval nuclei at tolerably regular intervals along their sides, were seen curling about among the medullated nerve fibres and presented a very striking resemblance to amyelinic nerve fibres. The fact that after treatment with picric acid they could be broken up into delicate fibrillæ, and that in a few cases the nuclei were seen to be surrounded by extremely thin but distinct ovoidal or irregular-shaped cell bodies, convinced the writer that they were in reality however nothing else than fibrillar connective tissue of a peculiar form.

In one tumour, and in only one, a considerable number of ganglion cells

was found. This tumour was formed upon one of the branches of the lumbar plexus, and was about 1 cm. in diameter and 1.5 cm. in length; it was symmetrical in shape, and the nerve entered it at either end. In a series of more than 50 sections from this tumour and the nerve on which it was formed, and in a large number of teased preparations of the same, except in the immediate vicinity of the ganglion cells, no amyelinic nerve fibres were found. These cells were all confined to a limited zone of the tumour about 2 mm. in thickness, and presented the usual diversity of form. The body was granular, the nucleus large and well defined, and usually contained one or more distinct nucleoli, and many of the cells contained larger and smaller masses of yellow or orange pigment. Each cell lay in a well-defined capsule, lined with flattened polygonal cells. The smaller ones had a diameter of .019 mm., the larger of .06 mm. The average diameter of all, taken from a large number of measurements, was .037 mm. According to Key and Retzius[1] the diameter of normal human sympathetic ganglion cells, ranges from .011 to .05 mm., the average being .025. (Fig. 5.)

Fig. 5.



Representation of two of these cells surrounded by their capsules; in A. a cell process is seen extending into the adjacent tissue.

The occurrence of ganglion cells in the multiple neuromata seems to be extremely rare; only two cases,[2] so far as the writer has been able to ascertain, having been recorded; and in one of these, the description of the cells was not so exact as to inspire much confidence in their identification. The occurrence of such cells would of course suggest the possibility of a connection of the tumour or its nerve with the sympathetic. But a most searching examination of the nerve and tumour above and below the point at which the cells were found, failed, as above stated, to give any evidence whatever that such was the case.

Finally, in regard to the nerve fibres in the tumours; in a few cases, especially in the dense fibroma, their diameter is diminished, as determined by measurement of the fibres in the tumour and in the nerves on which they are formed. In the majority of cases, however, the diameter is unchanged, except that sometimes a few fibres are seen here and there in the distinctly myxomatous tumours whose diameters considerably exceed those of any fibres in the corresponding nerve. It does not seem desirable

[1] Key and Retzius, Studien. Heft ii., p. 136.

[2] Knoblauch, De Neuromate et gangliis veris, etc., 1843, p. 30. Czerny, Archiv für klin. Chirurgie, Bd. xvii. p. 357.

to give the details of these measurements here; suffice it to say that the diameter of the fibres, as determined by several hundred measurements, ranged from .0024 to .0168 mm., while in some cases, within the tumours a few attained a diameter of .0216 mm. The nerve fibres pass through the tumours either in larger and smaller bundles, or run singly, being separated from one another by the new formed tissue. They pass for the most part, as determined by sections, parallel with the axis of the nerve, in straight lines or in broad sweeps; but in a few cases, they were found to pursue a most tortuous course, forming here and there large tangled knots in which the fibres run in all directions, twisting around one another and intertwining in the most irregular and intricate manner.

In many of the tumours the walls of the smaller arteries were greatly thickened, mainly by increase of tissue in the adventitial layers, and in a considerable proportion of the softer tumours the capillaries were excessively dilated, and in some cases distinctly pouched.

The microscopical examination of the above-mentioned fatty muscles of the leg showed the most exquisitely marked characters of progressive muscular atrophy, or, to use the nomenclature suggested by Friedreich, which more exactly expresses the character of the lesion, *Polymyositis chronica progressiva* with *accessory diffuse lipomatosis*. In the gastrocnemius where the lesion was most marked, almost no trace whatever of muscular tissue was left, the fat by which it had been replaced not even suggesting in its general arrangement the nature of the tissue whose place it occupied. This lesion of the muscles in our case is interesting not only as being the first case yet recorded in which multiple neuroma was complicated by this disease of the muscles, but also, on the other hand, as adding another to the diseases of the nerves which may possibly stand in etiological relations to this form of muscular disease.

In three of the cases analyzed below, "fatty degeneration" of certain groups of muscles was indeed recorded, but without a sufficiently detailed description to enable us to classify them definitely with the case in hand.[1]

If we limit the term, multiple neuroma, to those cases in which several nerve tumours are found on more than one main trunk or its branches, there are, so far as the writer has been able to discover, only forty cases yet recorded, exclusive of the one above described.

Although the extent of the lesion varies greatly in the different cases, the morphological characters are essentially the same in most of them, so far as the recorded descriptions permit us to decide. It seems to consist essentially in an increase in the connective tissue elements of both sympathetic and cerebro-spinal nerves, either in the form of a diffuse or circumscribed growth, giving now a simple thickening of the nerves, and again larger or smaller circumscribed tumours involving either the whole or

[1] The preparations of most of the above described tumours and nerves are deposited in the museum of the College of Physicians and Surgeons, New York City. Certain of these with an abstract of the case were presented before the Pathological Society of New York, at its session of Jan. 28, 1880, by Dr. T. E. Satterthwaite.

only a part of the nerve. The nerve elements proper may or may not be involved, and when they are, the observed changes seem in most cases to be secondary to the connective tissue's new formation. In a few cases, however, it would seem that a not inconsiderable portion of the tumours consist of new-formed amyelinic nerve fibres. These tumours are liable to have from the outset or to assume myxomatous or sarcomatous characters, and in the latter case the possibility arises of their becoming malignant by metastasis. Tumours, although of a less well-defined structure, may also occur in the brain. When, however, we consider the symptoms which these tolerably well-defined changes produce, we find a diversity so extreme that, when we remember the small number of cases yet known, it is no wonder that in the great majority of them the true nature of the disease was first revealed after the subject had been brought upon the dissecting table.

CASES II. and III.—The earliest recorded cases of this form of multiple neuroma are those of Monteggia[1] and Descot,[2] in which the entire nervous system presented numerous tumours, but of which no clinical history is preserved.

CASE IV.—In 1818, Schiffner[3] described the case of Florian S., aged 34, a cretin, small in stature, and never able to use intelligible language. Up to seven years of age he was unable to walk. At this time, without apparent cause, he was attacked with violent convulsions, which continued with little intermission for three days, after which by slow degrees he recovered and became able to walk, but with an unsteady gait. He was weak and puny, unsociable, and passionate; slept much of the time, and when roused to eat gorged himself to such a degree that vomiting frequently ensued. The most trivial excitement induced convulsions. When thirty-four years of age, in a fit of anger, he was seized with apoplexy, which terminated fatally in a few days. The brain was normal; the cerebral nerves, with the exception of the optic and fifth, were softened. Tumours were found on the eighth pair and on the pharyngeal and laryngeal nerves, which were also enlarged. The cardiac and œsophageal plexuses were enlarged, and presented numerous tumours, some of them as large as a filbert. The nerves of the cervical and tracheal plexuses were similarly affected from their origin in the cord outward. Numerous tumours were found in the nerves of the upper and lower extremities. The nerves of the sympathetic were unaffected.

CASE V.—In 1822, Schiffner[4] published his second case.

E. S., a younger brother of the former case, and likewise a cretin, died at 33, having been for a long time previously paralyzed in the lower extremities. No lesion of the brain or cord was noted. Numerous small tumours were found on various branches of the fifth nerve, on the facial filaments of the portio dura of the seventh, on the glosso-pharyngeal and pneumogastrics. In the cervical region the branches which the latter nerve sends to the larynx, as well as those by which it communicates with the sympathetic, were considerably enlarged, while in the chest numerous tumours were found on the œsophageal and pulmonic plexuses. Tumours were also found on the occipital, spinal accessory, and cervical nerves, and on those of both the upper and lower extremities. The right superior cervical ganglion was as large as a medium-sized filbert, as was also the inferior ganglion upon the left side.

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[1] Monteggia, Institutione chirurgische, 1813, vol. ii. p. 195: quoted by Wood in Edinburgh Med. Chir. Trans., vol. iii. p. 345.

[2] Descot, Dissertation sur les affections locales des nerfs, Paris, 1823.

[3] Schiffner, Med. Jahrb. des Oestreich. Staats, Bd. IV. St. 4, p. 77.

[4] Ibid., Bd. VI. St. 4, p. 44.

CASE VI.—In October, 1817,[1] a plasterer, thirty-nine years of age, unmarried, of fair muscular development, entered the hospital in Würzburg, having over the entire surface of the body down to the knees numerous painless movable tumours from the size of a hazel-nut to six or eight inches in diameter. These were congenital, and his father had suffered from the same evil.

Up to the summer of 1817, he had been in ordinarily good health. He now began to suffer from attacks of severe headache, which at first were not of long duration. They gradually increased in intensity and came periodically, mostly at night. They were preceded by a cold feeling along the spine, and followed by fever and sweating. During and aside from these attacks he suffered from nausea and bilious vomiting, and while they continued he was often very restless; the pupils were dilated, and sometimes double vision and strabismus occurred. The attacks continued to occur, greatly exhausting him, and he now became extremely weak and began to have pain in the knees and legs. A few days before his death he complained of numbness in the limbs which occurred periodically and interfered with movement. The headache diminished, but pain in the legs and loins increased, as did also his general weakness. He died quietly December 5, 1817.

The entire left half of the cerebellum was crowded back by the greatly swollen crus cerebelli; the right half of the cerebellum was regularly formed but crowded aside. The pons Varolii merged into the medulla and crura cerebri. No marked alteration in the cerebrum except a slight increase in the amount of ventricular fluids. The spinal cord and its membranes were normal except that several little fat? tumours were found within the canal. All the cerebro-spinal nerves were three or four times as thick as usual, and the smaller branches were beset with numerous tumours. The nerves of both upper and lower extremities, as soon as they emerged from the intervertebral foramina, presented themselves in the form of enormously swollen cords beset with tumours of varying size. The great sciatics at the upper portions were one and a-half inches in diameter. Some of the sympathetic ganglia were as large as a hazel-nut.

CASE VII.—Barkow[2] relates the case of Johann W., 30, cattle driver, narrow-breasted, and of weak intellect. He had suffered, so far as could be judged from his unsatisfactory account of himself, from successive attacks of pleurisy. Two years before his admission to hospital in 1822, he noticed a small painless swelling in the right calf. During the summer of 1821 it grew rapidly larger and interfered with walking, and finally the leg in its largest part attained a circumference of over eighteen inches. The corresponding foot felt heavy and numb, but the tumour was painful on pressure only at one point on the inner side of the leg. He was now lost sight of for a time, but in January, 1824, he presented himself again with the tumour greatly increased in size, and in the last stages of consumption, and died on the following day. The large tumour of the calf at the time of death was three feet one inch in circumference, its surface was nodulated, and it contained several cysts. The lower portions of the sciatic and the upper portion of the peroneus and tibialis were enlarged. Both pneumogastrics and many of their branches were thickened and presented numerous small tumours. The pulmonic and œsophageal plexuses were studded with small tumours. The right phrenic was somewhat enlarged near the heart; the sympathetic was normal.

CASE VIII.—Another Würzburg case occurring in Schönlein's clinic is described by Hasler.[3]

Barbara H., 20, single, admitted September 20, 1828. A few weeks before admission she fell into cold water, and traces her illness to that exposure. She soon began to have spasmodic pains, numbness, and formication in the arms; weakness followed, then extreme anæsthesia and paralysis, so that without support she could neither walk nor sit; the fingers became permanently flexed, and the neck muscles became so paralyzed that she could not hold the head upright; emaciation excessive. Later she experienced pain in the upper extremities and about the body and in the præcordia, and she had attacks of difficult breathing

[1] Heller, Virchow's Archiv, Bd. 44, p. 338. (This case is known as Hesselbach's case.)

[2] Barkow, Bemerkungen über d. Nerven Anschwellungen, 1829.

[3] Hasler, De neuromate—Turici, 1835.

and palpitation. A tumour was discovered under the right sterno-cleido-mastoid muscle which patient had not noticed before. A marked improvement was noticed under the use of strychnia. The attacks of palpitation and oppressed breathing soon recurred, however, and she experienced suffocative paroxysms similar to those noticed in animals after section of the pneumogastrics. The last of these she survived only two days, dying February 25, 1829. In the last days her appetite was poor, and she had diarrhœa.

Autopsy.—The tumour in the neck was formed by an enlargement of the superior cervical sympathetic ganglion, which measured three by two inches, was fibrous in texture, and had small nerves running over its surface. All the nerves joining the ganglion were notably enlarged, and presented several circumscribed tumours. The right pneumogastric was studded with small tumours, and several of considerable size were found within the spinal canal upon the roots of the cervical nerves.

CASE IX.—The next case, recounted by Knoblauch,[1] occurred in Bischoff's service in the Insane Asylum at Heidelberg, in 1840.

George A., an idiot from infancy, was slightly built, but of strong constitution and extremely indolent and passionate. He died at 38 years of age of pulmonary gangrene with pleurisy. No marked lesion was noticed in the brain or spinal cord. Two spheroidal tumours of the size of a mulberry were seen, one on either side, connected with the seventh nerves, just before their exit from the cerebral cavity. The third, fourth, sixth, and the three nerves of the eighth pair, as well as the hypoglossals and spinal accessory, all had small oval tumours at their roots. Most of the spinal nerves were considerably enlarged, and presented numerous larger and smaller tumours. The nerves and ganglia of the sympathetic were likewise unusually large. The cervical ganglia were nearly double their natural size. The semilunar ganglia each formed a tumour as large as a Spanish nut. The tumours presented the structure of fibroma, but some of them contained large, rather indefinitely described cells, which were believed to be ganglion cells.

In 1843, two very similar cases were treated in the hospital of the House of Industry in Dublin, and form the basis of the very excellent and finely illustrated monograph on the Neuroma by Mr. Smith,[2] of Dublin.

CASE X.—The first patient, John M'C., a cattle driver, who had been constantly exposed to the weather, by day and night, had been admitted to the hospital three years before, with a globular tumour about as large as a medium-sized cocoanut, on the right side of the neck, extending from the mastoid process to within a short distance of the sterno-clavicular articulation. The tumour was freely movable from side to side, but resisted attempts at longitudinal movements. It had existed for fifteen years, but had never been painful, and was now troublesome only in the inconvenience which its size occasioned. A small tumour, of the size of a walnut, was found under the tongue. The tumours were thought to be malignant, and the patient was discharged without operation.

In 1843, he was again admitted, complaining of severe pain in the left hip. A tumour about the size of a man's head was found on the posterior aspect of the left thigh, which had been growing for two years. His general health had greatly depreciated since his last admission; he was restless, without appetite, and sleepless, pulse frequent, respiration normal, no excess of perspiration, and no diarrhœa. He lingered for a few months, gradually wasting away, and died with hectic symptoms and without pain, but emaciated to the last degree. The tumour in the neck was no larger at the time of death than when he first came under observation three years before.

Autopsy.—In the right iliac fossa a tumour was found, three and a half inches long, and one inch in diameter, connected with the anterior crural nerve, several

[1] Knoblauch, De neuromate et ganglliis accessoriis veris, p. 27, Frankfort, 1843.

[2] The Neuroma. Robert W. Smith, Dublin, 1849.

filaments of which were spread out over its surface. The branches of the lumbar plexus were enlarged, some of the cords being three-fourths of an inch in diameter, and its branches were studded with tumours of various sizes, from that of an almond down. The left lower extremity presented a similar condition. Large tumours were found connected with both sciatics, that on the right measuring five by three and a half inches, that on the left ten by eleven inches. More than 550 tumours were counted on the lower extremities. A similar condition was found in the upper extremities, numerous tumours being present, not only on the larger trunks, but on the minute branches also. Numerous small tumours, from the size of a hempseed to that of a walnut, were found on the lingual, and three or four small tumours on the phrenics in the vicinity of the pericardium. The intercostals on both sides were greatly enlarged, but presented few distinct tumours. No marked alteration was noticed in the brain or spinal cord or their membranes, nor did the enlargement of the nerves in any case extend within the spinal canal. The total number of tumours removed from the body was more than 800.

Microscopical examination showed the tumours to be fibromata, developed in some cases from the intra-fascicular connective tissue, in others, apparently from the lamellar sheath.

CASE XI.—Dr. Smith's second case, Michael L., age 32, farmer, was admitted a few weeks after the death of the last case, presenting the symptoms of gastro-enteritis. Patient had always been healthy until a year before admission, when he contracted a severe cold and suffered much from pain in the limbs. He became emaciated, and the functions of the digestive system began to be deranged. On examination, subcutaneous tumours of various sizes were found on different parts of the body. One of these, of the size of a swan's egg, was situated between the tuber ischii and the trochanter major of the left side, and pressure upon this caused a sensation of pain in the leg, and produced a temporary contraction in certain fascicles of the glûteus maximus muscle, throwing them into prominent relief. The appearance of this tumour was said to have been preceded for six months by a sensation of the trickling of cold water down the limb. Six months before admission he first noticed the tumour, when it had the size of a gooseberry. He had suffered no injury at that point. Some of the other tumours were painful when pressed upon. Sensation and temperature of the surface were normal. He had no pain along the spine, but complained of a sensation of trickling cold, proceeding from the angle of each scapula, meeting at the spine, and passing down the back, dividing again at the sacrum, to follow the course of each sciatic. Latterly, his sleep had been broken, he lost flesh, stomach was irritable, food being frequently ejected shortly after eating, skin hot and dry, pulse 106. He died ten days after admission.

Autopsy.—Body greatly emaciated. Over 200 small subcutaneous tumours were scattered over the front and sides of the chest and abdomen. A considerable number was also found on the back. The branches of the right sacral plexus were much enlarged, and connected with them and nearly filling the true pelvis, was a tumour six by five inches, which compressed the rectum and bladder and contained numerous cysts filled with an albuminous fluid. The right sciatic throughout the greater part of its course was one and a half to two inches in diameter, and was composed of an agglomeration of oval or elliptical tumours. Tumours of various sizes were found on all the nerves of the right lower extremity, the total number being over 450. On the left side neither the lumbar plexus nor its pelvic branches was abnormal. The sciatic of this side was three-fourths to one-half an inch in diameter, and on its posterior surface just below its exit from the pelvis was a tumour five by four inches in diameter. The other nerves of this leg were studded with tumours, the whole number being over 300. In both upper extremities more than 300 tumours of various sizes were found. The pneumogastrics commenced to enlarge shortly before entering the chest, and throughout the whole thoracic portion formed trunks of immense size. On the superior portion of the right pneumogastric, which about equalled a goose-quill in size, was a tumour three-fourths by two and a half inches in diameter. Sixty tumours were found on the pneumogastrics and their communicating branches. The phrenic nerves were nearly twice their natural size, and presented near the

pericardium a series of oblong tumours, somewhat larger than a grain of wheat. The supra-orbital nerve was enlarged. Nothing abnormal was discovered in the brain or cord. The mucous membrane of the stomach presented the usual characters of chronic inflammation. More than 1400 tumours of the nerves were removed, and Dr. Smith thinks that if all were counted, the number would exceed 2000.

CASE XII.—Dr. Smith[1] mentions the case of an individual, then living, related to him by Dr. Henry Kennedy, which is probably to be classed with the disease we are considering. The patient, a gentleman, forty years of age, has had for sixteen years several small tumours on the legs and arms, which have never been in the slightest degree painful. They are hard and movable transversely but not longitudinally. They have gradually increased in number, there being now about 60 in all. As the new tumours appear, the patient is irritable, and experiences an ill-defined "peculiar" sensation in the part.

CASES XIII. and XIV.—At the sessions of the Academy of Sciences, in Paris, of April 3, 1843, Serres[2] described two cases of this disease. The first he had seen in 1829, the second shortly before his report. Both died of typhoid fever, and without any symptoms pointing to disease of the nerves. The anatomical changes were similar in both. Most of the cerebro-spinal nerves were thickened, and presented, all along their course, numerous ovoidal tumours of various sizes; these were most marked in the lumbar and sacral plexuses, in the great sciatics, and the pneumogastrics. In one case the sciatics were as large as an adult humerus and very nodular, while the pneumogastrics were twice the size of the normal sciatic, and beset with large tumours. Numerous tumours existed along the cords of the sympathetic, and many of the ganglia were greatly enlarged. In the case of 1829, more than 500 tumours were found along the nerves. In both cases the spinal cord was normal. The roots of the spinal nerves were, in most cases, normal, but a few of both the anterior and posterior were slightly enlarged. As soon, however, as the nerves had passed beyond the ganglia they became enlarged and presented tumours. In one case the intercostal grooves were considerably broader and deeper than normal for the lodgment of the greatly enlarged and nodular intercostal nerves.

CASE XV.—At the session of November 24, 1845, Serres[3] reported to the Academy another case observed by Maher and Payen.

The patient was a convict, twenty-six years of age. He had always been well, and was of a happy disposition. After his sentence, in March, 1845, he became sad and gloomy, his appetite failed, and he had an attack of diarrhœa which lasted fourteen days; he complained also of a sense of weariness in his legs on exertion and of stiffness of the knees. He recovered from his diarrhœa and appeared better, but, receiving at this time a mental shock, he relapsed, his strength diminished, he slept poorly, became apathetic and averse to exertion, and finally quite feeble; the diarrhœa returned, he rapidly emaciated, grew more and more despondent, and died with symptoms of typhoid fever. Muscular movements, although made with aversion, were at all times complete and regular, and there was no absence of general sensibility. He presented no sign of actual pain, and no symptoms were observed pointing to lesion of the nerves.

Autopsy.—Brain and spinal cord normal, with the exception of a slight injection of the pia mater cerebralis. Tumours were found in all the cerebral nerves except the auditory, olfactory, and pathetic. The pneumogastrics were enlarged throughout almost their entire course, and presented tumours of various sizes in all their branches. Some of the roots of the spinal nerves were slightly enlarged, but presented no distinct tumours. Beyond the ganglia, however, tumours of various sizes were found throughout their whole extent, in the trunk and extremities, except in the feet and hands, which were entirely free.

CASE XVI.—Gunsberg[4] describes the case of a man, who presented at first the symptoms of very intense general rheumatism with immobility of the members.

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[1] Smith, loc. cit.

[2] Serres, Comptes rendus de l'Académie des Sciences, vol. xvi. p. 643.

[3] Serres, Ibid., vol. xxi. p. 1171.

[4] Gunsberg, Ibid., vol. xvii. p. 989.

After several days of treatment, mobility was at first partially re-established, but difficulty of movement remained in the inferior extremities, and continued to augment during the following weeks until death, when there was complete immobility. In the last days he had incontinence of urine and feces. At the autopsy tumours were found on the third and fourth sacral nerves on both sides of the cauda equina. One tumour on the left side measured 1 by 1.5 cm. The structure was that of fibroma.

CASE XVII.—Serres presented the clinical history of still another case, then living, at the session of the Academy, in May, 1846.[1]

L., age 26, carpenter, had always been healthy; his antecedents were good, no venereal history. In April, 1845, after a day of hard work, and without premonitory symptoms, he became totally blind in the right eye, waking in the morning with vision lost and with ptosis palpebræ on the corresponding side. From this condition he had not recovered at the time of the report. In the same year he had an attack of pleurisy. In January, 1846, without premonition, while in the street, he suddenly felt a convulsive movement in the right thumb, accompanied by pain; the fingers of the same hand became flexed, the pain extended along the arm to the larynx, producing a sense of suffocation, and he was unable to cry out. These phenomena occurred within the space of one-half a minute, and he then lost consciousness. He soon recovered from this attack, but had another the same evening, which, however, was less severe; he had pain in the arm and flexure of the fingers, but did not lose consciousness. The next day he felt well, but the right arm was weak. Since this time he has had several more or less violent convulsive attacks similar to those described. He has become feeble and has considerable pain, especially in the arms and legs. Numerous hard spheroidal or ovoid tumours of various sizes were found in different parts of the body, some of them extremely painful on pressure, others quite insensitive. They are nearly symmetrical on the opposite sides of the body. His general health is fair, but he is emaciated; pulse and respiration normal; intelligence unimpaired.

CASE XVIII.—M. Morel-Lavallée[2] presented to the Surgical Society of Paris, at the session of April 18, 1849, a neuroma of the left median nerve, about the size of a turkey's egg, which had existed for a long time, with the following brief report. It had been painful for about four years, was somewhat movable, and had caused considerable weakness in the fingers of the corresponding hand. Some of the fibres ran over the surface of the tumour and entered it. All the cerebro-spinal nerves presented ganglioniform enlargements of various sizes. Both pneumogastrics presented tumours as large as a walnut; there was, however, no disturbance of the respiratory or digestive functions. The brain and spinal cord, as well as the sympathetic, were normal; the patient died of cholera.

CASE XIX.—At the same session of the Society, M. Giraldes mentioned the case of a person dying in a Parisian hospital (of what disease he did not state), who, during life, gave no symptoms pointing to disease of the nerves. All the nerves, however, were found beset with tumours, those on the pneumogastrics being as large as two fingers. Some of the nerve fibres passed over the surface, others entered the tumours.

CASE XX.—Lebert,[3] in 1853, records a case related to him by Dr. Sangalli, of Milan. A female, thirty-five years of age, presenting gibbosity of the spine, began to be subject to epileptiform convulsions at twenty-eight years of age. On her admission to hospital, a tumour of the size of a fœtal head (?) was found in the right inguinal region. Two other tumours of the size of a lemon were situated superficially in the left scapular region. She experienced no pain, either in or about the tumours. She died suddenly.

Autopsy.—Cysticercus in brain. The scapular tumours were fibrous in texture; with nerve filaments passing over the surface or entering the tumours at the ends. The inguinal tumour extended into the pelvis, and was surrounded by a chaplet of smaller tumours. The nerves in the extremities were not examined.

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[1] Serres, Comptes rendus de l'Académie des Sciences, vol. xxii. p. 879.

[2] Morel-Lavallée, Bul. de la Soc. de Chirurgie, t. i. p. 225–6.

[3] Lebert, Rapport sur le travail de M. Houels, intitulé Du Nevrome, Mém. de la Soc. de Chirurgie de Paris, t. iii.

M. Houels,[1] in the same year, describes the following case, which was treated in Nélaton's clinic.

CASE XXI.—Adrien B., age 26, shoemaker, admitted March 27, 1851, for operation on a tumour in the right groin. Five months before entrance to hospital, he noticed, for the first time, a swelling as large as a pigeon's egg in this region. It caused him slight pain, especially during changes in the weather. Several tumours as large as a grain of wheat were found in the abdominal walls, others in various parts of the body. Most of them gave him no spontaneous pain, and but slight pain on pressure. They were not adherent to the skin. His general condition was good, though he was somewhat emaciated. Certain muscles, especially those of the forearm, were slightly contracted. General sensibility intact. On April 1st, the tumour in the groin was removed; the healing of the wound was slow, not being completed until July; and during this time the other tumours were observed to increase in size. The muscular contraction now became more pronounced; patient complained of pain, especially on changes in the weather. He became still more emaciated; appetite good, respiration normal. Contraction of muscles increased, and movements became slow and embarrassed. General sensibility intact, or seemed even to be a little exaggerated. Toward the end of September patient took finally to the bed; the pains became more acute; did not seem to be localized in the tumours themselves, but were most marked in the forearms and knees. The legs became flexed on the thighs, and finally flexion of the thighs on the body occurred. Passive movements of the legs were still possible, but acutely painful. Later, movements in the superior extremities became impossible, and pressure on the tumours extremely painful; general sensibility still preserved. The number of tumours had now considerably increased. Opium by the mouth and subcutaneously relieved his pain at first, but toward the end was of little avail. In the last days, appetite almost completely failed, diarrhœa came on, respiration became embarrassed, pain more and more acute, slight degree of opisthotonos. Still the general sensibility, and also taste, hearing, and smell, remained intact. A bedsore formed over the sacrum; spontaneous luxation at the left hip joint occurred. Death on December 16th.

Autopsy.—Brain and cord normal, also the viscera. The cranial nerves within the skull voluminous. On the cauda equina numerous small tumours (the largest of the size of a pea) were found along the nerves; on one trunk twenty were counted. With the exception of the olfactory and optic, all the cranial nerves presented tumours of various sizes. The ophthalmic and Gasserian ganglia were very voluminous. Both pneumogastrics above the stomach presented numerous tumours, but on arriving at this point became normal. All the nerves of the upper extremities were notably hypertrophied and, with the exception of those in the palmar regions, were beset with tumours; one of these on the median and another on the radial were as large as a hen's egg. The lumbar and sacral plexuses were greatly hypertrophied, and presented numerous tumours, as did the smaller nerves of the leg, with the exception of those in the foot. There was general hypertrophy of the main trunks of the sympathetic in their cervical and thoracic portions, but no circumscribed swellings; in the abdominal portion they were nearly normal. The great splanchnic was voluminous, and presented small circumscribed swellings. Semilunar ganglion and its plexuses normal. Mesenteric plexus presents a few small tumours, the largest of the size of a hazel-nut. Structure of the tumours fibromatous.

CASE XXII.—Kupferberg[2] describes the case of a man sixty years of age, in whom six years after fracture of the right leg and without any special local symptoms, numerous tumours were developed. They were most numerous on the broken leg, but were found in the other leg and in the perineum, also in the right infra-clavicular fossa and near the right acromion. At the autopsy numerous tumours were found within the spinal canal attached to the cords of the cauda equina. They existed on the muscular as well as the subcutaneous nerves.

[1] Houels, Mémoire sur les Nevrome, Mem. de la Soc. de Chirurgie de Paris, p. 53, t. iii.

[2] Kupferberg, Beiträge zur Geschwulste im Verlaufe der Nerven. Mainz, 1854.

There was fatty degeneration of the muscles as well as of the nerve fibres. Structure of the tumours, fibroma and fibro-myxoma.

CASE XXIII.—Follin[1] mentions briefly, and without a clinical history, a case in which there were innumerable tumours scattered over the nerves, each of the filaments of the sciatics presenting several distinct nodules.

Temoin,[2] in 1857, recorded the following case:—

CASE XXIV.—Male, age 32, health good until fifteen years of age, when he remarked an insensitive tumour, of the size of a hazel-nut in the right submaxillary region, which seemed to be increasing in size. At this time he had violent toothache, which continued notwithstanding the extraction of several sound teeth. When sixteen or seventeen years old he observed tumours on the left arm, then on the left thigh, and on the fingers of the right hand, and finally in nearly all parts of the body. While small the tumours were not painful; when larger, pressure caused pain and momentary paralysis in the part. When twenty-four years old he had articular rheumatism, lasting five months. In his thirty-second year, considerably emaciated, he was admitted to hospital, and the tumours, which had not increased in size for some time, were most abundant on the breast, back, and arms. Pressure on some of those situated on the lateral walls of the chest, and on one about the size of a hen's egg, at the superior angle of the left scapula, caused pain and produced an uncomfortable sensation in the chest, and embarrassed respiration. The submaxillary tumour was spontaneously painful. There was no paralysis, no disturbance of function in the organs of sense, and his intelligence was intact. On the 7th of June, 1857, one of the tumours on the left radial was removed; a painful inflamed ulcer remained at the seat of operation, and the patient died on the 12th of July, of "purulent infection."

Autopsy.—Two metastatic abscesses in the liver. Brain, spinal cord, and cerebral nerves normal. The intercostal, as well as most of the other spinal nerves, especially toward their central end, were thickly beset with tumours. In the periphery the tumours were fewer in number. Both pneumogastrics, especially in the cervical region, presented a great number of tumours, many of them about the size of a hazel-nut; the pulmonic, cardiac, and visceral plexuses were free. A tumour was found on the cervical sympathetic. The tumours were fibroma, and the nerve fibres within them did not seem to be interrupted, but simply displaced by the new formation.

CASE XXV.—Wilks[3] presented to the London Pathological Society, in Nov. 1858, specimens of neuroma from a woman twenty-five years of age, of dissolute habits, but with no definite syphilitic history, and who, while in hospital, presented no symptoms of disease of the nervous system, but was treated for and died of phthisis pulmonalis. Tumours of the nerves were accidentally discovered when the subject came to be used for anatomical purposes. The cranial nerves were not examined, except the vagi and phrenics, the former of which was somewhat affected. Tumours of the nerves of various sizes, the largest on the sciatic, being as large as a pigeon's egg, were found in all parts of the body, as well as diffuse indurations. They had the structure of fibroma.

CASE XXVI.—The details of a case reported by Klob in the *Zeitschrift der Gesellschaft der Wiener Aertzte*, 1858, No. 13, p. 47, the writer has been unable to obtain.

CASE XXVII.—Another case was presented to the London Pathological Society, in 1861, by T. Smith.[4] Twelve neuromata were removed after death from a woman between sixty and seventy years of age. They were found on the internal cutaneous and posterior interosseous nerves of the arm, and varied in size from No. 6 shot to a walnut; the larger ones having existed for more than forty years. Their structure was that of fibroma.

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[1] Follin, Traité élémentaire de Pathologie, 1861, vol. ii. p. 318.

[2] Temoin, Bul. de la Soc. anatomique, Dec. 1857.

[3] Wilks, Trans. Path. Soc., London, vol. x. p. 1.

[4] Smith, Ibid., vol. xii. p. 1.

CASE XXVIII.—The following is a summary of a case described by Heller,[1] in 1865. J. F., male, age 45, teacher. In 1847 he was treated in a hospital for periostitis calcis dextra. Later, ulcers appeared on the leg of the same side, which, without much pain, increased in size, and finally became so extensive and troublesome that amputation was advised. This patient refused, and, though with intervals of improvement, his condition became worse and worse, until finally, in December, 1865, unable to use the legs and hobbling on crutches, he entered the hospital with a purulent, stinking ulcer covering nearly the entire lower part of the right leg and foot, and with four toes gangrenous. On December 18 the leg was amputated in the upper third. When patient came out of the chloroform narcosis, the author noticed a remarkable indifference to the pain of dressing the stump, although attention had not been before called to any lack of sensibility in the part. He died of pneumonia two days after the operation.

Autopsy.—Faulty development of external genitals—cryptorchismus. Pneumonia of right side. Nothing abnormal in brain or upper portion of spinal cord. From the second lumbar, all the roots of the spinal nerves were enlarged, forming, partly within and partly without the spinal canal, a succession of thick, knobby, fusiform masses. A tumour of the size of a hazel-nut was found within the dura, on the third and fourth left lumbar nerves, and also a number of such tumours on the nerves of the cauda equina. No tumours were found in the upper half of the body. In both thighs there were numerous fusiform tumours, both subcutaneous and muscular; one lying beneath the left sartorius measured 4.5 by 10 cm. The muscles in the upper part of the body were normal, but those in the lower part, especially in the left leg, presented the most extensive fatty degeneration, having entirely lost their natural color, and being converted into pure yellow masses. A part of the sympathetic ganglia was enlarged, forming dense fusiform masses, some of them measuring 2 by 4 cm. The author thinks, that, in addition to the increase in connective tissue which made up the bulk of the tumours, there was an actual proliferation of nerve fibres.

Hitchcock[2] gave an account, in 1862, of three cases, all belonging to one family.

CASE XXIX.—Mrs. C., age 81. No family history of importance, her parents had no tumours of any kind; she is healthy, and her mental powers are unimpaired. When thirty years of age tumours began to appear beneath the skin in different parts of the body. They gradually increased in number, and some of them in size. They have never been painful, except from injury, and the color of the skin over them remains unchanged. They are now spread over the entire surface of the body, being most abundant in the neck, thorax, and arms. They vary in size from a pin's head to a walnut. Some of them are hard, others soft, and present various forms. She has had seven children, several of whom died early of acute diseases. Samuel and Elizabeth both have tumours like the mother.

CASE XXX.—Elizabeth C., age 54. Tumours began to appear at ten years of age. One in the clavicular region, as large as a hen's egg, was removed when she was twenty-one years of age. Another was also removed from the lip. She thinks the rest have grown more rapidly since these operations, and she now has several on different parts of the body.

CASE XXXI.—Samuel C., age 46. When twenty-five years of age he first noticed a small movable tumour just above the inner condyle of the humerus; this slowly increased in size for twenty years, being painful only on strong pressure. Two years ago it began to increase rapidly in size, and now, on pressure, or when the arm is violently used, the tumour is painful, or a numbness, or a prickling sensation, or acute pain extends down to the fingers. On admission to hospital, the tumour measured six and a half by three and a half inches. It was removed, being found attached to the ulnar nerve, some of whose fibres ran over its surface. The nerve was severed in the operation. Other subcutaneous tumours were noticed at the time of the operation. The wound healed well, leaving paralysis of the parts supplied by the severed nerve. Eight months after, another tumour appeared at the seat of operation, which was very painful, and

[1] Heller, Virchow's Archiv, vol. xliv. p. 338.

[2] Hitchcock, Am. Jour. Med. Sciences, vol. xliii. p. 320.

increased rapidly in size, encircling the limb so that in one year the arm had a circumference of twenty inches. The other tumours had, in the mean time, increased in size and number. They were, for the most part, soft, some of them pedunculated, the largest of the size of a pea, and were chiefly found on the back, chest, and belly. A painful, cord-like mass was felt in the axilla, extending down toward the large tumour of the arm. Exarticulation at the shoulder-joint was now performed, and a dissection of the arm revealed numerous tumours along the nerves. The wound did not heal well, but continued unhealthy, raw, and bleeding. Patient lost flesh, and died from exhaustion seven months after the operation. No autopsy was made.

CASE XXXII.—In Heusinger's case,[1] described in 1863, the lesion of the nerves was coexistent with tuberculosis. The patient, 23 years of age, a tailor, was weakly built but healthy in early youth, and mentally sound. Began to cough and emaciate a year before death. On admission, he was extremely weak, had severe cough, sweat profusely, and had diarrhœa. In the intercostal spaces, and over the entire surface of the body, especially along the course of the large vessels and nerves, tumours were found, from the size of a hemp-seed to that of a bean. They were not attached to the skin, but gave to the latter, in many parts, a beaded appearance. They had scarcely attracted his atttention, and had given him no annoyance. They were regarded as degenerated lymph glands and vessels, associated with his condition of general tuberculosis. He grew rapidly weaker, and died, with symptoms of pulmonary œdema, soon after admission, having had no local pain.

Autopsy.—Lungs infiltrated with gray and yellow tubercles, no large cavities. Brain normal; cord not examined. Tumours were found on several of the cerebral nerves soon after their emergence from the bony canals. One as large as a pigeon's egg was found on one of the hypoglossal nerves. Both pneumogastrics were as thick as the finger, as were some of the trunks of the brachial plexus. The great sciatics, on emerging from the pelvis were two centimetres in diameter. The mesenteric nerves were studded with tumours, and looked like strings of pearls. The lesion was especially marked in the sympathetic. The protocol says, "Right and left from the vertebral column lies on either side a cord as large as the thumb, pouched like a large intestine, and sending off beaded cords to the organs, heart, chest-wall, etc." Beneath the diaphragm the cords were also beaded with tumours, from the size of a hempseed to that of a hazel-nut. On microscopical examination, the nerves within the tumours, which were fibromata, seemed to be normal.

CASE XXXIII.—Lebouey[2] records a case, without clinical history, in which there was a most extensive formation of tumours. They presented the usual variety in form and size, and were found in various branches of the third and fifth pair, in the pneumogastrics, and their laryngeal, pulmonic, œsophageal, and cardiac plexuses. The phrenics presented numerous nodules before passing through the diaphragm. The intercostal nerves were greatly enlarged and nodulated. One of the tumours on the median measured three by four inches.

CASE XXXIV.—Another extremely interesting case is that of Sibley.[3] Patient aged 45, coach painter. Had always enjoyed good health until seven years before death, when he began to feel himself growing feeble, but he had no more definite symptoms until four years before death, when the use of the lower extremities became impaired, and by degrees he lost all power of movement. A sloughing sore appeared on the back, and, when admitted to the Middlesex Hospital, he had no power of movement in the muscles of the lower half of the body, and the legs were drawn up to the abdomen; they could be drawn down, but would again soon become flexed. He retained some power of movement in the upper extremities, being able to feed himself if the food was cut for him. Cutaneous sensibility was entirely lost in the lower extremities, but a certain amount of sensibility remained in the hands. Urine and feces passed involuntarily. A

[1] Heusinger, Virchow's Archiv, Bd. xxvii. p. 206.

[2] Lebouey, Des Nevromes, Paris, 1863.

[3] Sibley, Med. Chir. Transactions, vol. xlix. p. 39, 1866.

large tumour was evident near left elbow, and another below Poupart's ligament of the left side. Appetite good. There was at first some improvement in the sloughing sore on the back, but it soon became worse, and patient died one month after admission.

Autopsy.—Body well nourished. No lesions of thoracic or abdominal viscera. Brain and cranial nerves normal. In the spinal canal numerous tumours were found within the membranes connected with the roots of the nerves, being most abundant in the cervical and lumbar regions. In the cervical region several tumours were found, the largest having the size of a large walnut, and pressing on the cord constricted and softened it. The large tumour noticed during life near Poupart's ligament was attached to the anterior crural, and contained several cysts. The tumours were fibromata.

CASE XXXV.—Generisch,[1] in 1870, gave an admirable account of a most interesting case. Karl P., age 22, shoemaker. His mother died of carcinoma mammæ. She had numerous tumours in the axilla, along the ribs, in the precordial region, and in the muscles. (These, at the time of her death, were supposed to be enlarged or cancerous lymph-glands, but in view of the history of her sons, and their situation, it is not improbable that at least a part of them were neuromata.) Patient had never previously had a severe illness. Early in 1818, after exposure to severe cold, he began to experience acute pain in the ball of the left foot, which was renewed at every change in the weather. This pain finally became so acute that he sought admittance to the hospital. He was of medium size, looked like a malarial patient, lips pale and bluish, conjunctivæ and mucous membrane of mouth singularly colorless. He was an epispadias, and his voice was like that of a child. Numerous larger and smaller resistant fusiform tumours were found scattered over the entire surface of the body, the skin over them being normal. Some of them were spontaneously painful, others, especially the smaller ones just beneath the skin, became so on pressure. Those of the size of a hazel-nut, or larger, also those lying deeper, were either not at all painful on pressure, or only when considerable force was used. He said that he first noticed them when eight years old. They gradually enlarged and increased in number, some of them being as large as a pigeon's egg.

An examination of the blood revealed an increase in the relative number of the white blood cells. Neither the higher senses, nor the sense of touch, nor perception of heat, nor muscular power, were in the least degree impaired. Respiration and heart functions normal. About ten weeks before death he began to have intense pressing, stretching pain in the right buttock, which increased in severity. A rapidly growing tumour was discovered here which at the time of death had a diameter of 35 cm. In the mean time he began to have pain in the right foot, and presently took to the bed. The right foot and leg now became slightly anæsthetic, and assumed a position resembling talipes equinus; and extensive œdema occurred, extending up to the middle of the thigh. Temperature ranged from 38.5° to 39.7° C.; pulse frequent and soft. A persistent diarrhœa now set in. A very painful digital examination of the rectum showed that the gut was pressed upon by a firm rough tumour within the pelvis on the right side. Later, micturition became difficult; urine scanty, cloudy, with reddish sediment, and on several occasions contained albumen. The painful and sometimes bloody diarrhœa was not controlled permanently by the most powerful remedies. A bed-sore formed over the right trochanter. During the last days he several times experienced a sensation of coldness, but had no pronounced chill. He died suddenly of pneumothorax.

Autopsy.—In the lungs were scattered areas of broncho-pneumonia and small cavities connected with the smaller enlarged bronchi, through the walls of one of which the perforation had occurred. On the surface of both lungs numerous wedge-shaped, soft, whitish nodules were seen, as large as a hazel-nut, with the broad end outward. Plugs were found in some of the smaller arteries in the lung tissue. A few scattered neuroma were found along the bronchi. Brain and cranial nerves within the skull normal. The roots of the ciliary ganglion and the ganglion itself were thickened and unusually resistant. Small tumours were found on the oculo-

[1] Generisch, Virchow's Archiv, Bd. xlix. p. 15.

motorius, right trochlearis, and on several branches of the trigeminus. The spinal cord was normal, but the spinal nerves outside the dura were much enlarged as they passed through the greatly widened intervertebral foramina, the change being most marked in the cervical and lumbar regions. The whole spinal canal was enlarged especially in the lower lumbar and sacral regions, having in the latter portion a diameter of more than 3.5 cm. Tumours of varying size were found in all the spinal nerves. The phrenics were beset with tumours of the size of a barleycorn. Both vagi were considerably enlarged and knobbed, and in some parts of the thoracic portion measured 9–12 mm. in diameter; upon and below the diaphragm were numerous tumours as large as a pea. Tumours were also found in the various plexuses. The sympathetic nerves were thickened and the ganglia enlarged. Both splanchnics and the intercostals present tumours, those of the latter nerve projecting through between the ribs into the pleural cavity. Several tumours were found in the subserosa of the stomach, in the porta hepatis, and were very abundantly distributed in the mesentery, the largest having the size of a pea. The true pelvis was filled with large subserous tumours, and such were also found in both iliac fossæ. Tumours of the size of a hen's egg were situated on the branches of the lumbar plexus, some of them containing cheesy masses, others completely calcified. The sciatics were enormously enlarged. The microscopical examination showed the tumours to be essentially fibromata, but some were distinctly sarcomatous, others myxomatous. The wedge-shaped masses in the lungs were sarcomatous, and the author regards them as metastatic. The above mentioned plugs in the smaller arteries of the lungs consisted chiefly of spindle-shaped cells somewhat resembling those composing the wedge-shaped nodules. The nerve fibres could be readily seen passing through the tumours, and the author concluded, after carefully counting the nerve fibres in transverse section before entering and within the tumours, that their number was not increased.

The following case was reported by Vallender[1] and Gerhardt[2]:—

CASE XXXVI.—Jacob P. (brother of the last case), aged 34, single. First began to talk when seven years old, and stammered excessively. When fifteen years of age he received a blow on the right temple, which was followed by a painful bump. In a few days the pain ceased, but a small hard tumour remained, which gradually increased in size, giving him however no inconvenience. His intelligence was much below the average. On admission to hospital subcutaneous tumours of various sizes were found in different parts of the body. One on the temple measured 5 by 2.3 cm., and one on the right side of the jaw, about as large as a hen's egg, was painful on pressure. Several of the larger tumours were painful on pressure, the smaller ones not. The patient was aware of the existence of the tumours on the forehead and jaw only. The genital organs were normally formed, but the penis was small, and patient had never experienced sexual desire. The higher senses, cutaneous sensibility, and muscular power were unimpaired.

On Sept. 12, 1874, he got thoroughly drenched, and remained several hours in his wet clothes. On the 13th, he had difficulty in swallowing, which increased during the next day. Well-marked tetanus was now developed, from which he died on the 18th.

Autopsy.—Everywhere beneath the skin, and in many muscles, small fusiform tumours were found upon the nerves. Both pneumogastrics and phrenics were beset with numerous fusiform tumours: one on the right pneumogastric, just below the base of the skull, being as large as a goose egg. The spinal cord and the roots of the spinal nerves were normal. The larger vessels of the cerebral pia were distended with blood, the smaller empty through compression. Pia œdematous, with much fluid at the base. In the central ganglia were spots of diffuse redness. On section of the brain, circumscribed resistant nodules were found, most abundant in the right side, and having an average diameter of 1 cm. These were found in the

[1] Vallender, De tumoribus fibrosis circumscriptis in tela cellulosa subcutanea. Berlin, 1863.

[2] Gerhardt, Archiv für klin. Medicin. Bd. XXI. p. 276.

left optic thalamus: on the right nucleus lenticularis and corpus striatum; in the vermis superioris cerebelli; in the cerebellar hemispheres; in the left corpus dentatum, and in both crura cerebelli. The microscopical examination of these nodules was not reported. The tumours of the nerves were fibromata.[1]

The following is a summary of a case briefly reported by Wegener.[2]

CASE XXXVII.—Patient was seven weeks ill with typhoid fever, during which time complete and persistent deafness occurred. Numerous subcutaneous spheroidal tumours of various sizes up to that of a large hazel-nut were scattered over the body, movable but not painful. With the exception of the deafness, there were no symptoms pointing to disease of the nerves. Patient died in convalescence, from intestinal perforation.

At the *autopsy* numerous tumours were found on the pneumogastrics as they entered the chest. All the spinal nerves presented numerous tumours of varying size, which were especially abundant on the lumbar and brachial plexuses, and on the sciatics; they were also very abundant on the subcutaneous nerves, which in many cases presented a beaded appearance. Tumours were also found on the cervical sympathetic and along the lesser curvature of the stomach, also on the phrenic nerves. The brain and cranial nerves within the skull were normal, as was also the spinal cord. The nerves of the face were not examined.

The microscopical examination is said to have shown that the tumours were composed of amyelinic nerve-fibres.

The following case was described by Bruns,[3] in 1870.

CASE XXXVIII.—P. M., male; 33 years of age; general health good. He was born with a flat tumour on the left temple and left upper eyelid, which grew with the growth of the body; it was lobulated, irregularly nodulated, hanging in sack-line folds down to the ear covering the eye whose bulbus was atrophied. Knobby cords were felt within the tumour which has given him no special inconvenience. Six years ago he first noticed a tumour on the left side of the neck which was then about as large as a hen's egg, and lay just below the angle of the jaw. It continued to increase in size, and he came for operation. It was now about as large as the double fist, reached from the jaw to the clavicle and forward to the median line, displacing the larynx. It was freely movable sideways, but not up and down. The skin over it was normal. At first he had for a time no subjective symptoms, but two years before admission he began to suffer from a gradually increasing hoarseness which, however, never reached aphonia. During the last six months he had darting pains in the tumour, radiating to the ear and back of the head, as well as difficulty of breathing, which was accompanied by a whistling sound, especially after exercise. Vigorous movement of the tumour or strong pressure on it induced cough. On various other parts of the body hard tumours were found from the size of a barley-corn to that of a walnut, of whose existence he was unaware. An operation was performed for the removal of the tumour of the neck. On cutting down upon it a nerve was seen to enter it from below which proved to be the pneumogastric, and was severed. During the operation violent cough and intense suffocatory symptoms occurred, passing off after the manipulations ceased, when the breathing became normal. Patient did well until the tenth day after the operation when a profuse hemorrhage occurred terminating in death.

Autopsy.—The hemorrhage was occasioned by an ulceration through the wall of the carotid. The left vagus was beset with fusiform and spheroidal tumours from the size of a millet seed to that of a bean, down to its finest visible ramifications. On the right vagus tumours were found as large as a walnut. Tumours were also discovered on numerous other nerves; especially on the bra-

[1] This case was made the subject of an inaugural dissertation by Dr. Carl Rump, in which the histology of the tumours is described at length, and which is epitomized in Virchow's Archiv, Bd. lxxx. p. 177.

[2] Wegener, erliner Klin. Wochenschrift, No. 2, 1870.

[3] Bruns, Virchow's Archiv, vol. l. p. 108.

chial plexus, the subcutaneous nerves, and on the sciatics and their branches. Some of these were as large as a pigeon's egg.

A brother of the above patient had a congenital elephantiasis with plexiform neuroma of about the same size and shape and in the same region, and his mother had numerous wart-like tumours in the skin.

CASE XXXIX.—Czerny[1] records a case somewhat analogous to the last, in which an elephantiasis coexisted with multiple neuroma.

Therese G., age 25. Her great grandmother, grandfather, and mother were the subjects of more or less extensive elephantiasis, the character of this disease in the mother being, in many respects, similar to that in the daughter. Patient was born with a small tumour of the back, which grew rapidly, hanging down over the right buttock to the knee, producing deformity of the spine. The outer and front sides of the right thigh became covered with hard thick skin beneath, and within which a congeries of flattish spheroidal tumours of various sizes formed a thick knobby mass.

Various operations were attempted for the removal of portions of the large tumour, which became ulcerated in several places and undermined by abscesses, but she bore them badly. High fever and chills developed, paralysis of the left leg and partial paralysis of the left hand occurred, and she died of exhaustion.

Autopsy.—Several small abscesses were found beside the middle meningeal arteries, and a thrombus of the middle cerebral. Small abscesses and infarcta were found in the liver, spleen, and kidneys. Aside from the plexiform neuroma in the hypertrophied skin, in the right side of the pelvis and lying on the quadratus lumborum muscle, which was fatty, a great mass of larger and smaller tumours, involving the branches of the lumbar plexus, was found. The nerve cords connecting these tumours were greatly thickened, and the tumours and thickening of the nerves extended inward through the intervertebral foramina which were greatly enlarged. One of these tumours 4 by 2.5 cm. in diameter lay within the dura mater, compressing the cauda equina. The sympathetic in the same region was excessively involved, forming a part of the tumour mass.

The branches of the external and middle cutaneous presented beneath and within the thickened skin the usual characters of the plexiform neuroma. Other tumours were found along the leg. They were for the most part composed of connective tissue, although in some cases amyelinic nerve-fibres preponderated. Some contained numerous, very much elongated, cells which the author regarded as immature amyelinic nerves. Ganglion cells were also found in some.

The case reported by Prof. Kosinsky, of Warsaw,[2] in 1874, is in some respects unique, and, if it indeed belongs among the cases we are now considering, of great interest from the therapeutic standpoint:—

CASE XL.—A. B., age 30, soldier. When about sixteen years of age he first noticed several small painless tumours on the right lower extremity. Subsequently when marching they began to grow and become painful. They were over 100 in number, and were scattered over the posterior and outer surface of the thigh to its lower third, and also on the buttock. They were spheroidal or ovoidal, mostly hard, and varied in size from a pin's head to a hazel-nut. The skin in their vicinity was dry, rough, and scaly. Pressure, especially on the larger tumours, caused intense radiating pain. Walking induced pain, but when at rest it passed off. They corresponded to the branches of the lesser sciatic and external cutaneous.

After a trial of various medicaments a portion of the lesser sciatic was excised, and while the wound was healing by suppuration the tumours began to diminish in size, and after four months many of them had entirely disappeared, and the remainder gave him no trouble whatever.

In 1878 Gerhardt[3] described a new case whose prominent features are the following:—

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[1] Czerny, Archiv für Klin. Chirurgie, Bd. xvii. p. 357.

[2] Kosinsky, Centralblatt für Chirurgie, July 18, 1874.

[3] Gerhardt, Deutsches Archiv für Klin. Med., Bd. xxi. p. 268.

CASE XLI.—P. R., age 30, day labourer. Father died at 50 of nervous fever. Mother healthy, but occasionally has cramps of the legs. Since early youth he has had numerous hard tumours beneath the skin in various parts of the body which have not been painful, and have not increased in size. After getting wet through while heated, he began to feel pain in the cervical region, and some of the vertebræ became unusually prominent. The left arm and hand grew weak, and subsequently the left lower extremity. He experienced the sensation of a band around the body; had pain in the back, and convulsive movements in the left hand and foot. On admission to the hospital in Würzburg (the fifth Würzburg case), he was well nourished; head held to the left; partial paralysis of the left facialis. Memory and intelligence unimpaired. Atrophy of muscles in the upper extremities, and finer movements of the fingers imperfectly executed. Partial paralysis of both legs, with constant fibrillar and fascicular twitchings in left thigh. Sensibility diminished in both forearms and legs. Numerous tumours evident in various parts of the body, one as large as a hen's egg. Pressure on the sciatics caused severe twitching in the muscles of the thigh. Patient died of typhoid fever, exhausted by profuse bloody diarrhœa.

Autopsy.—The usual lesions of typhoid fever were found. Brain anæmic; nerves of basis intact. Small tumours were found on the oculo-motorius, trochlearis, abducens, and on the branches of the fifth pair and glossopharyngeals. Both pneumogastrics were studded with tumours as large as a bean in the cervical region, and many were found on the thoracic plexuses and along the bronchi far into the lungs and in the larynx.

In the spinal canal, in the cervical region, and in the foramen magnum, small tumours lay upon and compressed the cord and medulla, and the intervertebral foramina in the cervical region were enlarged and filled with tumours and swollen nerves. The brachial and lumbar plexuses were greatly enlarged and covered with tumours, forming large, shapeless, knobby masses. The left sciatic was so large that it could hardly be surrounded by the fingers of one hand, and the right was about two-thirds as large. The flattened fusiform tumours on some of the subcutaneous nerves of the thigh were so abundant as almost to conceal the muscles beneath. In the sympathetic also the lesion was extensive, especially in the superior thoracic region. At the origin of the aorta and pulmonary artery, a large compound tumour quite surrounded the vessels, and had produced considerable erosion of the vertebræ beneath. Various branches of the sympathetic in the abdomen and pelvis were thickened and beset with tumours. In front of the left kidney lay a tumour one-fourth larger than the organ itself, connected above with the solar plexus. At the porta hepatis lay numerous masses of tumours, and some were found along the arteries within the organ, even out to the finer ramifications. The mesentery was studded with small tumours; many were scattered over the surface of the intestines; several lay along the seminal vesicles and beside the pancreas.

With the hope of establishing some other means of definite diagnosis than extirpation, Gerhardt made some interesting observations on his patient with the galvano-puncture. Selecting a tumour on the outer side of the rectus femoris, which seemed to belong to the cruralis, a fine needle connected with the cathode was carried into it, while the anode by means of a moistened sponge was put in connection with the skin over the patella. By the use of five elements only, contractions were produced in the vastus externus, while by cutaneous galvanization alone, twitching was first produced by the use of twenty-five elements. A few days later the experiment was repeated, when eight elements were necessary to produce the contractions. When the needle was stuck into a small superficial tumour of the cutaneous nerves, after a short time, pain regularly occurred, followed by strong reflex spasm of the whole extremity. In view of these results, the author suggests the possibility of a physiological diagnosis of the neuroma.

If now we make a brief analysis of these records, we find that in the 32 cases in which the sex is recorded, 24 were males, 8 females. The average age at the time of death is 34. The duration of the disease it is difficult to determine, on account of the entire absence of symptoms, which

many of the cases present in their early stages; but in some, the tumours were observed at a very early age, and in others they were unquestionably congenital. The association of the specific nerve lesion with neuroses and malformations is worthy of remark. Two cases were cretins, one an idiot; two are recorded as of weak intellect; one was a crypsorchis; in one the penis was small, and there was entire absence of sexual proclivity; in one there was an inconsiderable irregularity in the lobulation of the lungs; one was an epispadias. In two the lesion was associated with elephantiasis. The clinical history is most remarkable in the variety and lack of uniformity of the symptoms, and the marked discrepancy between these and the anatomical lesion in many of the cases. In the 26 cases in which a fairly complete account of the symptoms is preserved, 12 presented no symptoms whatever pointing to a lesion in the nervous system. In the remaining 14, a greater or less degree of paralysis was present in 8; more or less pain was experienced in 13, and this of the most varied character; sometimes spontaneous, sometimes occurring only on pressure on the tumours, and in some cases influenced by atmospheric changes. Diminution in cutaneous sensibility was observed in 4 cases; convulsive movements in 4; abnormality in respiration in 4; palpitation in 1. Headache was a prominent symptom in 2 cases, in one of which there were brain lesions. Leucocythosis was observed in 2 cases; alteration of the muscles in 3. Diarrhœa occurred toward the end of life in 6 cases, contributing to, or inducing the condition of weakness and debility in which many of the cases died. Among the immediate causes of death we have: typhoid fever, 5; cerebral apoplexy, 1; gastro-enteritis, 1; cholera, 1; phthisis pulmonalis, 3 (one with tubercle); pulmonary gangrene with pleurisy, 1; pneumothorax, 1; pneumonia, 2; tetanus, 1; hemorrhage, 1; pyæmia, 1; and the remaining cases terminated, for the most part, in general debility and exhaustion, some with hectic, others with diarrhœa. Tumours in the brain were found in 2 cases; within the spinal canal in 4. They were found in most of the peripheral nerves in 27 cases, and were confined to special groups of nerves in 10. The sympathetic was affected in 14 cases. The pneumogastrics were affected to a greater or less degree, sometimes excessively so, in 17 cases; only 3 of these, however, presented abnormalities in respiration, and 1 of them suffered from palpitation. (The remaining case in which affection of the respiratory movement occurred was living at the time of the report.)

Further, the subjects of this disease, so far as the records show, as a rule, bear operative interference badly; in some cases the remaining tumours having grown more rapidly after operation; in others the wounds healed slowly; in some, the patients dying from exhaustion, and in one from pyæmia. In regard to the remarkably frequent occurrence of typhoid fever in these cases, little more can be said at present, than that it is, at least, a dangerous complication. It may be further noted that the special

senses are usually unaffected, but there are exceptions. The lesion of the nerves does not, in most cases extend into the hands and feet.

So far as the diagnosis is concerned, it will be seen, from the above analysis, that it is at best uncertain and difficult. Pain, which is so frequent an accompaniment of the single neuroma, is here frequently entirely absent, and when it does occur is often not definitely localized. There may also be the most perfect control of muscular movement while enormous changes have occurred in both central and peripheral nerve trunks. Numerous hard or soft tumours, in different parts of the body, arranged along the course of the nerve trunks, ovoidal or fusiform in shape, not attached to the skin, and movable transversely, but not longitudinally, whether painful or not, may justly give rise to a suspicion of the existence of this disease; and the galvano-puncture, as a possible means of diagnosis (Gerhardt, loc. cit.), is to be borne in mind.

A consideration of the propriety of employing the term neuroma, for tumours which, in the majority of cases, do not apparently contain new-formed nerve-tissue, would carry the writer beyond the scope which he has assigned to the present paper.

ARTICLE XI.

ON THE PHYSIOLOGICAL ACTION OF POTASSIUM NITRITE. By EDWARD T. REICHERT, M.D., Demonstrator of Experimental Therapeutics in the University of Pennsylvania, WITH A NOTE ON THE PHYSIOLOGICAL ACTION ON MAN, by S. WEIR MITCHELL, M.D., Member of the National Academy of Science.

THE very great value of amyl nitrite in warding off impending paroxysms of epileptic convulsions, angina pectoris, and asthma, has been so generally recognized by the profession, that the discovery of a new salt whose physiological action is identical with it, and yet which possesses some superior therapeutical properties, must obviously elicit in the clinician a deep interest similar to that experienced by the experimental therapeutist. The very prompt and efficient action of amyl nitrite in the treatment of the above diseases is undoubtedly dependent upon both its physical and physiological properties, and it is concluded that its exceeding volatility imparts to it an action of extraordinary rapidity, as well as of notable transientness. It must therefore be apparent that what the salt has thus gained in the rapidity of its action it has lost in permanency, and on this account has been found to be entirely unsuitable for constant administration when it has been deemed advisable or necessary to maintain a continuous systemic influence, and it has therefore been found to be therapeutically of little value in the treatment of the above diseases, except

when it was possible to use it in warding off impending paroxysms, the therapeutist in the interim being compelled to resort to such other medicines as have been found valuable, though unfortunately oftentimes not efficient.

It is, therefore, evident that if a preparation could be obtained whose physiological action would prove to be identical with that of amyl nitrite, but whose effects would be more permanent and therefore suitable for maintaining a continuous systemic influence, we would have an addition to our materia medica which would fill a very apparent therapeutic void: for if amyl nitrite has proved so valuable in the treatment of certain paroxysmal disorders, why should not a salt with greater stability of action be equally as efficient in the treatment of these cases in the interim? Such a preparation of greater stability of action we have in the potassium nitrite, and while studying its physiological action I purpose discussing in connection with it the experimental researches on amyl nitrite, which have been made by different investigators, hoping thereby to make the subject of the identity of action at once evident, and at the same time to note certain errors that have occurred in the conclusions drawn from the results of some of their individual studies.

I take great pleasure in expressing my obligation to Dr. S. Weir Mitchell for his kindness in furnishing me the potassium nitrite for physiological experimentation, and for the detailed results of the experiments made upon himself, as well as those made by one of the students at the University, under his supervision and direction.

General Action.—In *frogs*, the drug in large or toxic doses causes at first a state of restlessness and excitement which lasts for a few minutes; this condition is succeeded by one of quietude, and attended with a progressive depression and final extinction of muscular irritability, as is evinced by the inco-ordination of voluntary movements and ineffectual attempts to jump, and finally by the complete absence of irritability to galvanic stimuli. Consentaneous with the incipient period of locomotor depression, the animals merge into a condition of narcotism, in which state, when they are placed upon their backs, they are unable to resume their normal postures, or indeed may show no tendency whatever to do so. Reflex action is also diminished. Immediately following this well marked narcotic state, muscular twitchings occur which are not unfrequently succeeded by convulsions and death. Convulsions do not invariably occur, but when present are clonic in character, and are usually preceded by either twitchings or well-marked spasms in groups of muscles. Occasionally a tetanoid condition is present. Notwithstanding the diminution of reflex irritability which was noticed to occur previous to the convulsive stage, yet during the existence of the latter, reflex irritability appeared occasionally to be somewhat restored, for it was found that very slight mechanical stimulus was sufficient to cause very pronounced con-

vulsions. This fact suggests a depression of inhibitory reflex centres, or asphyxia, for it was found that in animals poisoned with the potassium nitrite, the blood was of a uniform dark venous colour, having a peculiar chocolate shade. This will be more fully referred to hereafter. (See *Blood.*)

In the lower *mammals* the stage of excitement is not generally well marked, and, as has been observed, is frequently altogether absent. If the stage of excitement is present, that of depression rapidly supervenes, and if the dose be toxic it gradually deepens into death. Both the pulse and respiration rates are notably increased. The pulse is increased in frequency, but diminished in force, as is shown by tracings made with the kymograph, and if the dose be toxic, the increase gradually subsides to the normal, and continues sinking till death ensues. The respirations after large doses are profoundly affected, and may be increased from one-half to two-thirds that of the normal, being also deeper; after very large or toxic doses they become frequent, deep, and laboured, and not unfrequently extremely hurried and panting, and then gradually becoming slower and shallower as death approaches. Reflex activity is diminished and muscular inertia appears. If the dose be lethal, death ensues from a failure of the heart or respiration, consciousness remaining present almost to the end, and sensibility being but slightly impaired. Convulsions were seldom observed to occur in these animals.

In *man* the greatest interest of an experimental study of the physiological action of any drug must naturally centre, I therefore give somewhat in detail the results of the experiments made by Dr. Mitchell, the student above referred to, and by myself, upon our own persons.

The following is the report handed me by Dr. Mitchell:—

"Last autumn Prof. Wolcott Gibbs asked me to study the physiological effects of the alkaline nitrites—and furnished me with specimens. I began in October by testing them carefully on myself, and found that in doses of four to seven grains they caused acceleration of the heart's action and a sense of cerebral fulness, with flush of face and sometimes of the extremities. I then placed the specimens in Dr. Reichert's hands, and while he was making the physiological study which he now reports, made, or had made, with the aid of Mr. Guy Hinsdale and Mr. Angell, a fuller but as yet too brief study of the effects of these drugs on man. I have also begun to give them in epilepsy, and suggest their use in the chill of ague and in eclampsia, as well as in asthma.

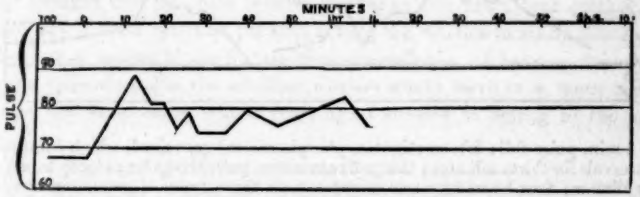
"The following are as yet the only experiments made on man in health. My therapeutic examinations I hope to publish before long, as well as a detailed account of the effects of alkaline nitrites in healthy people when given steadily in various doses, small or large.

"*Feb.* 3. I took in the morning fasting, six grains of potassium nitrite, my pulse being 78. As I was occupied in seeing patients, I did not notice the heart until

after the lapse of 40 minutes, when it began to be felt. It was then 110. The vessels in the neck were throbbing slightly, and my face felt warm. At the 120th minute I took again 6 grains, the heart being down to 90, but it seemed to me to be more than usually excitable from an active run up stairs. The new dose again in 30 minutes raised the pulse to 110, and a little later to 118; I also felt more fulness of head. Doses of 2 grains thrice daily did not alter the pulse. At first the medicine gave rise to unpleasant regurgitation, having a taste like that of phosphorus. This no longer troubled me if I took the drug fasting and with an excess of alkali.

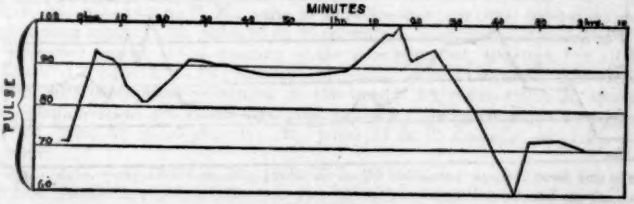
"24*th*. Having made several like testings, I took within a half hour 10 grains. This in 25 minutes sent my pulse to 120, flushed my face, and my hands also, and caused a sense of intra-cranial throbbing. In a word, the potassium nitrite caused all the symptoms which are more abruptly developed by amyl nitrite. I add the following careful records of experiments made on himself at my request by Mr. Guy Hinsdale, student of the University of Pennsylvania:—

"*March* 27, 1880. *Experiment, No.* 1.—Dose, 5 grains per stomach.



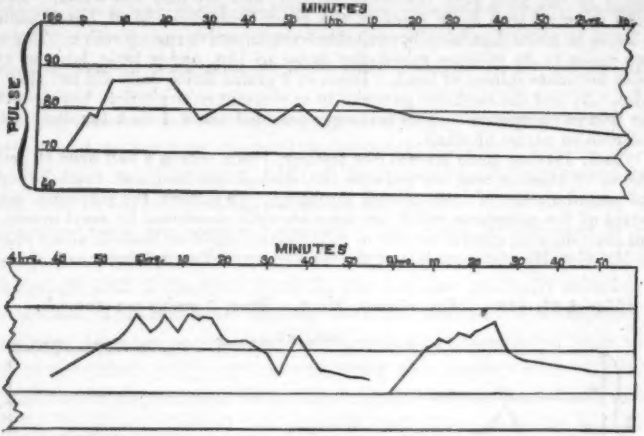
"5 min., pulse full, sensations of slight fulness in the head, and some flush in the face; twelve minutes, pulse full and hard; twenty-five minutes, escape of gas from the stomach tasting like phosphorus, which continued at intervals for fifteen minutes; seventy minutes, pulse irregular. At the end of four hours the pulse was seventy-six, and throbbing of blood in the head noticed, but not very annoying. *Temperature*.—Normal temperature, 98.8; in ten minutes, 98.6; fifteen minutes, 98.6; twenty minutes, the same; thirty minutes, the same; forty minutes, the same.

"*April* 3, 1880. *Experiment, No.* 2.—Dose, 3 grains per stomach.



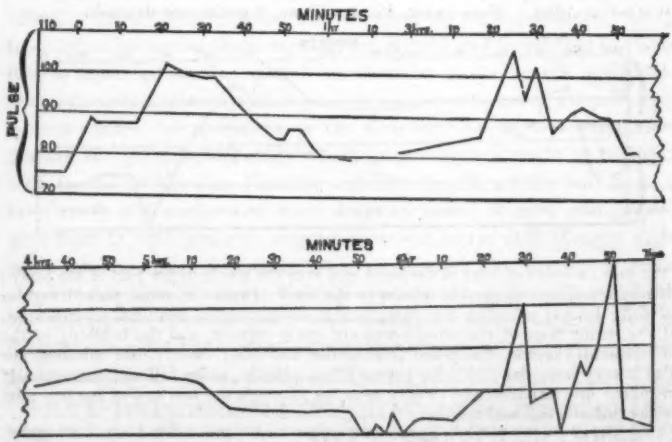
"2 min., a sense of heat in the head and over the whole upper part of the body; three minutes, a disagreeable fulness in the head; twelve minutes, pulse irregular and full; twenty minutes, the disagreeable feeling in the head has disappeared, but the strong taste of the phosphorescent gas is present, and the belching of the gas frequently occurs, the pulse is irregular and full; twenty-four minutes, the pulse is very irregular and full; seventy-five minutes, pulse full and outrageously irregular; one hundred and twenty minutes, through the last half of the last minute the pulse is full and regular.

"*April* 5, 1880. *Experiment No.* 3.—Dose 3 grains per stomach.



"5 min, pulse full; fifteen minutes, phosphorescent gas raised, which continued at intervals for thirty minutes; thirty-five minutes, pulse irregular; eighty minutes, took dinner; four hours fifty-two minutes, took three grains of potassium nitrite; fifth hour, a slight feeling of heat in the face; fifth hour three minutes, phosphorescent gas raised from the stomach, which continued at intervals for a half hour; sixth hour forty minutes, took supper; ninth hour five minutes, took three grains of potassium nitrite; thirty minutes, escape of phosphorescent gas; tenth hour, six minutes, pulse 76. Between the first hour three minutes and the fourth hour forty minutes the pulse-rate gradually declined, and between the fifth hour forty-five minutes it gradually declined up to the ninth hour, when another dose was taken, which sent it up again.

"*April* 29, 1880. *Experiment No.* 4.—Dose, 7 grains per stomach.



"1 hr. and 30 min., took dinner; third hour fifty-eight minutes, took ten grains potassium nitrite; fourth hour five minutes, flush of face and warmth of body; fifth hour forty-seven minutes, took eight grains; sixth hour three minutes, took five grains; thirteen minutes, took five grains. The whole amount of the salt taken during the day was thirty-five grains. The pulse at 6 A. M. the following day was sixty. Between the first hour ten minutes and the third hour the pulse-rate gradually rose, and after the seventh hour gradually sank until the ninth hour twenty minutes, when I retired for the night.

"It is clear from these brief studies that it is possible to take considerable doses of the nitrites without injury. The irregularity of heart caused by them is remarkable, and it remains to be seen if their chronic use will cause the same results.

"I was not sure that the heart became feebler as the pulsations increased in frequency, although that was what I believed likely to occur. Mr. Hinsdale thought that his pulse became weaker as the heart beat quicker. I have now several epileptic patients taking the nitrites in rising doses with the view of seeing if the fits are thus controllable. I have no doubt that in the epileptic status the alkaline nitrites would have in a more lasting shape the same value which years ago I showed to belong to the amyl salt."

The following experiments were made upon myself:—

Exp. No. 1.—At 12.58 P. M., pulse 17 in 15 seconds; .59, took four grains of potassium nitrite; at 1 o'clock, a slight sense of warmth is experienced in the stomach, and a sensation of slight fulness with a desire to belch; at .02, pulse 18 in 15 seconds; .05, pulse 20 in 15 seconds, a slight flush in the face is apparent; .07, after stooping a moment my face became greatly flushed; .09, pulse 20 in 15 seconds, and slightly irregular, a sensation of diffused warmth is experienced, especially so in the feet and hands; .13½, pulse 20 in 15 seconds; .21, pulse the same, an occasional flushing is felt, and a small amount of gas has been raised from the stomach, which has a taste resembling very closely the disagreeable fumes given off from burning sulphur matches; a slight fulness is experienced in the head; .30, pulse 21 in 15 seconds, I can appreciably feel the pulsations in my head; .40, pulse 19 in 15 seconds; .50, pulse 20 in 15 seconds; at 2.04, pulse 19 in 15 seconds; .17, pulse the same; .35, pulse 17 in 15 seconds.

Exp. No. 2.—At 9.08 P. M., pulse 34 in 30 seconds; at .08½, took eight grains of potassium nitrite; .09, pulse 36 in 30 seconds, a sensation in stomach as if gas had collected there; .14, a flushing of the face apparent, although but slightly marked; .17, pulse 37 in 30 seconds; .27, pulse 40 in 30 seconds, face slightly flushed, with perceptible pulsations in the head; .33, pulse 40 in 30 seconds; .39, phosphorescent gas raised from the stomach; .48 pulse 40 in 30 seconds; at 10.04, pulse 38 in 30 seconds; .30, pulse 34 in 30 seconds; at 11.25, pulse the same.

Exp. No. 3.—At 10.04 A. M., pulse 38 in 30 seconds; at .05, took ten grains of potassium nitrite; .06, a fulness in the stomach is experienced and an emission of the disagreeable phosphorescent fumes; .07, pulse 39 in 30 seconds, a slight warmth is apparent, which is universally diffused over the whole body, but especially in the lower limbs; .10, pulse 43 in 30 seconds; .13, pulse 44 in 30 seconds; .20, pulse 45 in 30 seconds; .29, pulse 48 in 30 seconds; since .07 I have experienced transient flushings of my face at brief intervals, and at present it is flushed with an appreciable feeling of fulness in my head; .41, pulse 48 in 30 seconds; when I arose from my chair the very slight exertion caused my heart to beat rapidly and violently, and each pulsation was distinctly felt in my head, and indeed also heard, for each pulsation was distinctly audible, and seemed as though the carotids were beating violently against the skull; .49, pulse 45 in 30 seconds; at 11.15, pulse 49 in 30 seconds; .27, pulse the same, transient flushes still expe-

rienced; .37, pulse the same; at 12, pulse the same; at 1, pulse 50 in 30 seconds; .50, pulse 48 in 30 seconds; I have been slightly nauseated since twelve o'clock, and at 1.30 vomited—the nausea and vomiting I attribute to the extreme disagreeableness of the phosphorescent fumes generated in the stomach, and not to any specific action of the drug on the stomach or vomiting centres; at 2.45, pulse 50 in 30 seconds; 3.40, pulse 44 in 30 seconds; 4.40, pulse 36 in 30 seconds; 5.25, pulse 38 in 30 seconds; 6.30, pulse the same. After the vomiting I felt much better since very little of those nauseating fumes were emitted, yet a slight feeling of discomfort was experienced until late in the afternoon, but by six o'clock I felt entirely recovered and fully enjoyed my dinner. I also noticed during this last experiment that my heart was exceedingly irritable, and that slight exertion, like climbing the stairs, would cause the pulsations to become markedly accelerated. Although I took no particular note of the respirations, yet they did not appear to be appreciably affected by these doses.

It will be noticed in comparing the results of the above experiments made by Dr. M., Mr. H., and myself, that there is quite an appreciable difference in the action of the salt on the pulse of each of us. Thus, the record obtained by Dr. M., when compared with those made by Hinsdale and myself shows that he is more susceptible to it, for although both Hinsdale and myself took doses equally as large, yet in no instance did we find a rise as great. (Dr. M. however tells me that he is particularly susceptible to medicines which act on the heart.) It is also noticeable that the pulse-record obtained by Hinsdale shows more or less oscillation in the number of beats; while that obtained by myself shows that the pulse rose continually to the maximum and remained within several beats of it until the return to the normal. Hinsdale makes frequent note of the irregularity of the heart, but Dr. M. makes no mention of this, and in myself very little irregularity was apparent.

The *local action* is in all respects identical with that of the amyl nitrite, excepting that it is irritating. The marked paralysant effect, when applied to any of the highly organized tissues, is very prompt, this action being of a physiological rather than of a chemical character, since the tissues will occasionally regain their functional activity, even after almost a complete suppression has occurred. The drug is irritating, causing pain when injected hypodermically, or when applied to a raw surface; and when placed on a motor nerve I have frequently witnessed marked fibrillary contractions occur in the muscles supplied by its filaments, although I have never observed any reflex action to supervene upon its application to a sensory nerve of a decapitated frog, or any movement occur when placed upon a striated muscle. When a few fragments of the crystals are placed upon the exposed heart of the frog, an irregular contraction occurs, in which condition the point of the viscus on which the poison was placed appears as if thrown into a state of tonic contraction, as is evident by the depressed condition of the heart's surface and the pale anæmic appearance, which was obviously due to the contraction of the fibres thus acted upon, causing a bloodless condition of this poisoned area.

Conclusion.—*Local Action.*

Potassium Nitrite: When locally applied is an irritant, and a depressant to all the highly organized tissues, the diminution or loss of function being of a physiological and not of a chemical character.

Amyl Nitrite: "Nitrite of amyl causes a progressive loss of functional power in every highly organized tissue with which it comes in contact. . . . If the contact be not continued too long, the tissue may recover even after a total suppression of its function."[1]

Nervous System.—Upon the *brain* the salt evidently possesses some slight narcotic influence, although this action is so far superseded by others more potent, that it sinks into insignificance. In mammals I have not unfrequently noticed a disposition to sleep after large hypodermic injections, but have never observed any marked narcotic effects. In frogs, however, as has been before mentioned, a different result was obtained; and in animals in which the skullcap was removed and the solution or crystals applied directly to the cerebral surface, it was found that within twenty seconds after the application of the poison the animal became restless, the restlessness being speedily followed by narcotism which was very pronounced after two and a half minutes from the time of administration. The convulsions which have been referred to as occurring in frogs and occasionally in mammals, are of cerebral origin, and not peripheral, as has been proven by the following investigation: In order to determine this point a number of frogs were taken, and either the abdominal aorta or one of the femoral arteries was ligated, thus excluding the access of the poison to both or one of the posterior extremities, and it was found that convulsions of the whole body and extremities still occurred when the non-poisoned limbs were irritated, showing that the convulsions were not peripheral in origin. Another lot of frogs were then taken, and section of the spinal cord made in the upper dorsal region, and sufficient time being allowed to elapse for the animals to recover from the shock of the operation, the drug was given as before, when it was found that unexceptionally when convulsions occurred they were present in the anterior extremities alone, showing that they must therefore be of cerebral origin; this fact being somewhat substantiated by their being clonic in character. The occurrence of convulsions in mammals being so exceptional, caused a further investigation of this comparatively unimportant action in them to be passed by without a more detailed experimental study. Brunton (*Journal of Anatomy and Physiology*, vol. v. p. 72) and Wood (*Therapeutics*, 1879, p. 349) believe the convulsions to be of cerebral origin and due to asphyxia. Meyer and Friedrich (*Archiv Experim. Path. Pharm.*, vol. v. p. 58) states that the tetanoid condition (see *General Action*) must be due to an irritability of the spinal cord, but this conclusion is scarcely

[1] The quotations on the action of amyl nitrite cited in the conclusions are from Dr. H. C. Wood's Therapeutics, Phila. 1879, pp. 346–352.

tenable because this condition may be due to asphyxia, or a depression of the inhibitory reflex centres of the cord, and no spinal irritability was proven by them to exist.

Conclusion.—*Brain.*

Potassium Nitrite: On the brain of mammals it possesses a very feeble narcotic influence; on the frog it is more marked. The convulsions are clonic in character and cerebral in origin.

Amyl Nitrite: "Convulsions . . . are in all probability cerebral, not spinal, and due to the asphyxiating influence of the poison."

Upon the *spinal cord* the salt exerts a marked paralytic action, and the loss of voluntary motion and reflex activity is undoubtedly dependent to a very great extent upon this action, although, as will hereafter be seen, both the nerves and muscles are alike deleteriously affected. Reflex activity is progressively diminished from the first, never being preceded by an increase (Wood—Amyl nitrite, *loc. cit.*), and generally after the lapse of about twenty or thirty minutes from the time of administration of the salt has suddenly and entirely disappeared. The progressive diminution of reflex irritability was in several instances in my experiments, interrupted by a return of reflex activity, partially at least, to the normal; the probable reason of this being, as before stated, asphyxia or a depression of reflex inhibitory centres. The cause of the sudden cessation of reflex irritability, as was noted to occur in most cases, I have as yet been unable to experimentally determine. If a concentrated solution or a few fragments of the crystals be placed upon the exposed cord of the frog, the irritant action is at once evinced by the muscular twitchings which occur in the posterior extremities; this irritant action is followed by one of powerful and progressive depression which gradually deepens into a condition of complete paralysis, affecting alike both the motor and the sensory centres. Thus I have found that mechanical irritation of the cord above or at the poisoned area, would cause a very feeble response in the posterior extremities, as compared with that previous to the administration of the poison; and that after a while even mechanical stimulus failed to elicit a response, although a weak faradic current would produce the desired result. Shortly, even this current was found to be of no avail, and a constantly increasing strength of current was necessitated in order to obtain the slightest evidences of its application; finally, even the strongest current obtainable from a Leclanché cell and a Du-Bois Reymond Induction Coil failed entirely to cause the least perceptible effect. When the cord was now stimulated below the poisoned area, it was found that the strongest current failed to elicit any reflex movements in the anterior extremities, although feeble stimuli caused marked response in the posterior extremities; and when applied to the upper non-poisoned area it caused very pronounced reflex movements in the anterior extremities. These facts certainly show that the failure of the cord to convey impulses generated above the

poisoned area through it to the motor nerves was due to a paralysis of either or both the motor centres or motor conducting fibres; and that the failure to conduct impulses upwards when the cord was galvanized below the poisoned area, was due to a paralysis of either or both the sensory centres or conducting fibres. It seems therefore proven from the results of the above investigations, that if the salt is applied to the spinal cord in concentrated form, it acts as a direct local irritant, this action being dependent upon peculiar chemical properties, and is not physiological in character—for we have already been made aware of its irritating nature when locally applied, and that when small diluted quantities reach the cord, as after hypodermic administration, no such action is present; therefore, the true physiological action is that of a powerful depressant (Wood—Amyl nitrite, *loc. cit.*), both the motor and sensory portions becoming alike depressed, and finally completely paralyzed. It seems evident, however, when we refer to the general action of the salt, that the motor portions are by far the most susceptible to this toxic influence, being the earliest to succumb, and are undoubtedly very greatly depressed before the sensory portions are to much of an extent affected (Wood, *American Journal of the Medical Sciences*, July, 1871, pp. 48, 49).

Conclusion.—*Spinal Cord.*

Potassium Nitrite: Both the motor and sensory portions are alike deleteriously affected, becoming depressed and finally completely paralyzed; and that the motor portions are by far the most susceptible to the poison, being greatly depressed before the sensory portions are much affected.

Amyl Nitrite: "On the motor centres of the cord the nitrite acts as a direct and powerful depressant . . . over the sensory . . . centres . . . has but little power, they are among the last portions to be affected."

The action on the *motor nerves* is identical with that on the motor portions of the spinal cord. Thus, it was found that when the crystals or a saturated solution were applied to the sciatic nerves, fibrillary contractions of the muscles occurred to which the filaments were distributed, although this was not as in the spinal cord invariably the case. This irritant action is soon followed by one of a very pronounced paretic character, by which the functional power of the nerve is rapidly and progressively diminished and finally completely extinguished, for it was found that powerful galvanic stimuli elicited no response whatever in the muscles supplied by the poisoned nerve, although the muscles themselves were irritable. No condition of irritation of the nerves can be detected after hypodermic injections, but the marked depression is, however, always pronounced, and this is no doubt the true physiological action of the salt—the irritated condition, like that of the spinal cord, being dependent upon the peculiar chemical properties of the salt, being only observed when it is locally applied in concentrated form.

Conclusion.—*Motor Nerves.*

Potassium Nitrite: The functional power of the motor nerves is progressively diminished, and finally completely extinguished.

Amyl Nitrite: "On motor centres . . . is a direct and powerful depressant, . . . exerts a similar but less pronounced action on the nerves, . . . decreasing but not destroying their functional life."

The *sensory nerves* are also depressed and finally paralyzed, for in several experiments made upon frogs it was found that within two minutes after the local application of the potassium nitrite to the sciatic nerve, no reflex phenomena could be induced by galvanization of the nerve on the peripheral side of the poisoned portion, although the reflex response was very prompt when the nerve was irritated on the central side. By referring again to the general action of this salt, it appears probable that an appreciable diminution of the function of these nerves does not occur until very late in the poisoning, and that practically, therapeutic doses have no effect. The lateness of the occurrence of a diminution of sensation has been noticed by several experimenters in their investigations with the amyl nitrite.

Conclusion.—*Sensory Nerves.*

Potassium Nitrite: The sensory nerves are depressed and ultimately paralyzed, but are not depressed to any appreciable extent by therapeutic doses.

Amyl Nitrite: "Over the sensory nerves . . . has but little power, they are among the last portions of the body to be affected."

In a further experimental study in frogs of the action on the nervous system to find the order in which the different portions were functionally extinguished, it was found that the centres of the cord were seriously affected before the nerves and muscles, and that cerebral paralysis preceded all of them, for even after unconsciousness supervened reflex phenomena could be induced. In a number of animals in which either the abdominal aorta or both femoral arteries were ligated, thus cutting off access of the poison to the nerves of the posterior extremities, after a while it was found that no reflex response could be induced by galvanization of the sciatic nerve, showing that the non-transmission of the impulses thus generated must be due to a depression of some portion of the cord, for certainly the sensory nerves must still be intact and capable of conveying impulses, as such is shown to be the case in an unpoisoned animal similarly operated upon, or when a single femoral artery was ligated, the same result being observed, no difference which nerve was stimulated. In another series of experiments, it was found that no reflex phenomena were present when the sciatic nerve was galvanized, yet, when the electrodes were placed upon the exposed spinal cord, a marked response was seen in the muscles of the posterior extremities. The total absence of reflex irritability in these cases, and the presence of irritability in the motor portions

of the cord, suggests at once that such a loss was dependent upon a paralysis of the sensory centres. But this inviting explanation is undoubtedly erroneous, for we have already seen that sensation is among the last portions of the body to be seriously affected, and that mobility is impaired first. The true explanation probably is that the sensory portions of the cord are depressed, but the motor portions are more profoundly so, although the centres are still capable of perceiving and reflecting impulses generated by *powerful* stimuli. Further investigation shows that after the motor centres and tracts fail entirely to convey impulses to the motor nerves, yet, when the electrodes were applied to the sciatic, a marked contraction of the muscles of the extremity occurred. Even after no perceptible effort could be induced by galvanization of this nerve with the strongest current, the muscles were still found to respond to galvanization, although feebly. The results of these experiments indicate that the cerebral functions are the first to be completely extinguished, followed by the motor centres, motor nerves, sensory centres and nerves, and muscles. It is impossible, so far as our knowledge goes, to determine in the above instance the exact relation which the time of the occurrence of the paralysis of the sensory centres and nerves bears to the other parts of the nervous system.

The *circulation* is profoundly affected, both the pulse and arterial pressure giving striking evidences of a very powerful influence. Thus, the *pulse-rate* is from the first increased, with diminished force, and, if the dose be large or toxic, finally subsides to the normal, and continues in a steady decline till death or a reaction ensues. In man, as is shown in the experiments previously recorded, the increase amounts to from about one-third to one-half of the normal; in dogs and cats it is equal to about one-half of the normal. In these latter animals it was found that the increased pulse-rate occurred after section of the vagi nerves, suggesting that it was due to a depression of the inhibitory centres. Filehne (*Pflüger's Archiv*, Bd. ix. p. 490) and Mayer and Friedrich (*Archiv Exper. Path. Pharm.*, v. 63) conclude from their experimental studies that this is the *modus operandi* of the action of the amyl nitrite. The former observer, after dividing the vagi nerves of a rabbit, found a galvanic current of such a strength, which, when applied to the peripheral vagi trunks of the cut nerves, would restore and maintain the normal frequency of the cardiac beat; and he found after the injection of the amyl nitrite that the pulse-rate was not accelerated. Mayer and Friedrich found that in animals poisoned with amyl nitrite, the production of sudden asphyxia would not cause inhibition of the heart, as in the normal animal; and, further, that when the access of blood was cut off from the cerebral centres, the pulse was not quickened, as was the case in the normal animal. Pick (*Centralblatt f. d. Med. Wissens.*, No. 55, 1873) asserts that the increase is not only due to the depressed state of the inhibitory apparatus, but also

to the effort of the heart in endeavouring to overcome the sudden dilatation of the arterioles, which allows such a large quantity of blood to pass through them as to require an unusual amount of work to be done by this organ. The conclusions arrived at by these observers are so confirmatory of each other, that it is but just to accept as a fact that the depression of the inhibitory apparatus is the prime cause of the increase. Here I find that the results of my own investigations are somewhat at variance with those given above, for, notwithstanding the fact that the increase still occurred after section of the vagi nerves, further experimentation has proven that this action is one directly on the heart muscle, for the increase was present after the isolation of the heart from the influence of the central nervous system, although this appeared to be not so great as when the vagi nerves alone were divided. The increased pulse-rate must then be due to both a direct action on the heart and possibly to a consentaneous depression of the inhibitory centres. It has been further experimentally proven that the force of the pulse is materially lessened from the first, as has been plainly shown in kymographic tracings. These show that the pulse is greatly increased, with a very small pulse-curve during the rise of pressure (see arterial pressure), and, after the rise has attained its maximum, the pulse becomes slower and the curves higher, and then again becoming more frequent and the curves smaller. It has also been found that the decline in the pulse-rate occurs after isolation of the heart from any centric nervous influence, showing that this also is a direct cardiac action.

Conclusion.—*Pulse.*

Potassium Nitrite: The pulse-rate is primarily increased, and secondarily diminished; the increase being due to a direct action on the heart and probably to a consentaneous depression of the inhibitory centres; and the decrease to a direct depressant action on the heart.

The *force* of the pulse is diminished.

Amyl Nitrite: "The whole evidence seems to show that the . . . rapid stroke of the heart . . . is due at least in part to a depression of the inhibitory cardiac nerves. In the later stages of the poisoning . . . the heart-force itself being largely extinguished by a direct action of the poison on the muscle."

The *arterial pressure* is greatly affected from the first, and is differently influenced by various sized doses. Thus, it was found in dogs that large intravenous injections (.5–1 gram.) caused the pressure to fall immediately and progressively to zero, the animals, no doubt, expiring from cardiac paralysis, since the respirations continued for a few moments after the cessation of respiration, and as the autopsies revealed a diastolic condition of the heart attended with almost an entire absence of irritability. In cats and rabbits .2 gram. or possibly even less will produce an analogous effect. Much smaller doses will almost invariably cause a temporary rise of pressure, which lasts for about half a minute, this being followed by a fall, which if the dose be toxic, is progressive to zero. This was also the re-

sult observed in animals with cut vagi. In three cats, one with cut vagi, the rise of pressure after intravenous injection of .08 gram. was equal to about one-sixth of the normal, the rise lasting for about thirty seconds and being followed by a gradual but very marked fall, in one instance equal to one-third of the normal, and in the other two to zero. Consentaneous with the appearance of the change in pressure, both the respiration- and pulse-rates became very much increased in frequency. In a large dog with cut vagi nerves, to which an intravenous injection of .2 gram. was given, an appreciable rise of pressure occurred which lasted for about two minutes, and appearing in connection with this was an increase in the number and depth of the respirations, and an increase of the pulse with an appreciable diminution in the force. The pressure then began to subside, and fell equal to about one-tenth of the normal, when a second dose was given. The respirations then became greatly increased in depth and violently hurried, the pulse-rate was markedly accelerated and attended with a considerable diminution in the force, and the blood pressure arose equal to about one-half of the normal. After the pressure subsided and seemed fairly on the road to a progressive fall, a third dose was given which again caused a slight rise; the respiration-rate became fully doubly increased and panting; the pulse became slowed. The pressure then fell slowly and continuously for about six minutes, the respirations becoming slow and shallow and gradually sinking as death ensued. The result of this experiment is given somewhat in detail because of the apparent dependence of the rise of pressure upon the very marked changes which take place in the respirations, both in regard to the depth and frequency. It has, however, been found in experiments made on curarized animals in which artificial respiration was maintained, that a rise of pressure still occurred, independent of any respiratory action which obviously could not occur under these circumstances because the disturbing influences of the profoundly altered respirations were overcome. I have further found that after section of both the vagi nerves and the upper cervical spinal cord, the same changes in the arterial pressure were present, but the rise was decidedly more marked than it was in the normal animal.

The result of this last investigation seems to be confirmed by Brunton (*loc. cit.*), in his experiments with amyl nitrite. He found that although no rise of pressure occurred in normal animals, yet it sometimes occurred in animals in which the spinal cords were cut and aortas compressed, and amounted to about one-fifth of the normal. The difference in the results thus obtained by him thrusts upon us a question of considerable interest to decide, and if these results be accepted as accurate, which they justly claim to be since they came from such a reliable source, it shows at a glance that these changes in the arterial pressure are dependent upon a duality of action, and that the depression of pressure which was observed to occur in the normal animal at the first, supersedes a secondary

action which was also present, but which was not apparent except in animals with cut cervical cords, and compressed aortas. The explanation of this complex action will be evident by studying the results of my own investigations with the potassium nitrite, and it will, therefore, be fair to reiterate some of my previous statements, that the principal points may be directly before us: first, it has been found that the arterial pressure is primarily increased, and secondarily diminished; second, that this increase and diminution still occur after isolation of the heart from the influence of the central nervous system; third, that the rise of pressure is decidedly more marked after section of the spinal cord in the upper cervical region, than it was in the normal animal; fourth, large intravenous injections cause an immediate and progressive fall of pressure to zero.

We have here, therefore, three prime facts: first, that the increase of pressure occurs after isolation of the heart from any centric nervous influence showing a direct action on the heart; second, that the decrease of pressure also occurs after isolation of the heart from any centric nervous influence, showing also a direct action on the heart; third, the rise of pressure is decidedly more marked after section of the cervical spinal cord than it is in the normal animal, indicating that the vaso-motor centres in the normal animal are so depressed that the vascular dilatation is able to overcome to a certain extent the stimulated action of the heart. It will, therefore, be plain that the reason why ordinary doses increase the blood pressure in the normal animal, is because the stimulated heart is able for a time to overcome the effect caused by the depressed vaso-motor centres, this conclusion being substantiated by the fact that the rise of pressure was even more marked after destruction of the vaso-motor centres (section of cervical spinal cord) than was the case in the normal animal; and the reason why the pressure falls for the first after large intravenous doses, is because the stimulant action on the heart is superseded, the organ becoming overwhelmed by the paretic action; and in this depressed condition associated with a similar depressed condition of the vaso-motor centres, of necessity the pressure must progressively fall. It was, however, asserted that the increased pulse-rate was associated with a diminished force, which might seem somewhat contradictory to the above statement that the heart was stimulated, but the fact that the action of the heart is able to overcome the vascular dilatation due to the depressed vaso-motor centres, is sufficient evidence to show that the increased frequency more than compensates for the diminished force.

It is now very easy to explain the diversity of the results obtained by Brunton, if we assume that the amyl nitrite acts in proportion more powerfully on the vaso-motor system than does the potassium salt, and, indeed, this assumption is clearly indicated to be a fact if we compare the action of the two salts on man, when we find that the amyl nitrite will cause an intense suffusion of the face within a few moments, while

that observed after giving the potassium nitrite is not so intense nor is it so marked for a considerably longer period. The reason why Brunton did not get a rise of arterial pressure in normal animals was because the action on the vaso-motor system was so intense, that it was impossible for the increased action of the heart to overcome the dilatation of the vascular channels, which is clearly proven by the fact that the increase did occur when the vaso-motor centres were anihilated, and a great part of the dilatable vessels occluded by the compression of the aorta. Pick (*loc. cit.*) asserts that the accelerated action of the heart is in part a compensating one in endeavouring to overcome the action of the suddenly dilated arterioles, which allows of an augmented quantity of blood to pass through them, and hence of the increased cardiac effort. But this compensating action must be a very subsidiary one, since the pressure is so much increased above normal, and as it is certainly due to a direct stimulation of the heart, as has already been conclusively proven.

That the vaso-motor system is depressed I have experimentally determined by examining the web of a frog's foot under the microscope, and also the rabbit's ear, when it was found that distinct dilatation occurred. The dilatation of the arterioles caused by amyl nitrite has been noticed by Brunton (*loc. cit.*), Wood (*loc. cit.*), Amez-Droz (*Archiv de Physiologie Normale et Pathologique*, Sept. 1873), Aldridge (*West Riding Reports*, vol. i. p. 187), Pick (*loc. cit.*), Filehne (*loc. cit.*), and Schuller (*Berlin. Klin. Wochenschrift*, No. 25, 1874), all of whom found distinct vascular dilatation, but who are somewhat divided as to whether this action is centric or peripheral, or both. Brunton and Wood found a distinct dilatation occur even after section of the cervical spinal cord, when of course in all these instances the peripheral vaso-motor mechanism was absolved from any centric influence; and Schuller found that after section of the sympathetic nerve in a rabbit a dilatation still occurred. They therefore conclude that the vaso-motor dilatation is exclusively peripheral —a conclusion which is rather hasty and untenable, since it does not prove the absence of a depression of the centres, but merely shows that the peripheries are so affected. On the other hand, it has been found that by galvanization of the cervical sympathetic, the vessels in the rabbit's ear were capable of contraction, suggesting that the action must be centric; although this view is opposed by Pick (*loc. cit.*), who states that the explanation of it is that the arterioles are not so profoundly affected as to be incapable of responding to powerful stimuli. Filehne asserts that if the sympathetic nerve of one side of a rabbit's neck be divided, that the vessels of the uninjured side are to a greater extent dilated than are those of the injured side.

I think, therefore, in summing up the results of the above investigations, that the only proper conclusion is that both the centres and peripheries are depressed. In my own experiments on the vaso-motor system,

it was found that in curarized animals the galvanization of a sensory nerve would not cause a rise of pressure so great as was the case before giving the potassium nitrite, and that by testing at intervals of a few minutes it was found that this diminution of effect was continuous and progressive, but gradually wore away as the animal recovered; or if the dose was toxic, continued diminishing till death. Further, it was found, as before stated, that after section of the cord in the upper cervical region, the rise of pressure caused by the stimulated heart was more marked than in the normal animal. Also, that the arterioles later in the poisoning do not respond to stimuli to the same extent as they do normally; and in repeating Filehne's experiment an identical result was obtained. This result was so evident that when an assistant was asked, "In which ear are the vessels the most dilated?" answered without hesitation, "The ear of the left side," which was the side with the sympathetic intact. It was also distinctly noticeable that the vessels were not in a state of continuous dilatation, but that a rhythmical alternate dilatation and contraction occurred, and that it was not until late in the poisoning that the vessels remained constantly dilated. I think, therefore, that the results of these experiments distinctly prove that the vaso-motor centres are depressed from the first, and that it is probable that the peripheries are not to a considerable extent affected until late, as the vessels do not appreciably lose their irritability until the system is profoundly under the toxic influence, and probably in therapeutic doses are practically unaffected, the vascular dilatation being alone due to a centric action, which is strengthened by the fact of the occurrence of the transient flushes occurring in man, and the alternate dilatation and contraction occurring in animals, as above noted.

Conclusion.—*Arterial Pressure; Vaso-Motor System.*

Potassium Nitrite: The arterial pressure is primarily increased, due to a direct action on the heart; secondarily diminished, due to vaso-motor and cardiac paralysis.

Vaso-Motor System: Both the centres and peripheries are depressed.

Amyl Nitrite: "It is evident that, at least in the early stages of the poisoning, the diminution of arterial tension must be due to dilatation of the capillaries. . . . . Very late in the poisoning the heart itself was acted upon.

"It seems to me established that nitrite of amyl does act locally on the coats of the arterioles, although it may at the same time influence the vaso-motor centres."

The *respiration-rate* in mammals is very much affected, and after the administration of small doses is increased from one-half to two-thirds more than the normal, while at the same time they are also somewhat increased in depth. If the dose be large or toxic they become exceedingly frequent and panting, gradually subsiding to the normal; or if the dose be lethal,

they become slow and shallow, diminishing until death ensues. After large intravenous injections they are intensely affected, becoming exceedingly hurried, panting, and violent; or if the dose be sufficiently large, are almost immediately arrested. In experimentally determining the cause of the increased respirations, the vagi nerves in a number of animals were severed, and a tracheal tube inserted so that the paralyzed laryngeal muscles would not interfere with the breathing. As a result of these investigations it was found that the respirations were as markedly increased as they were in the normal animal, thus showing that the action of the drug must be that of a stimulant to the respiratory centres, although it is probable that this action is an indirect one because of the drug's asphyxiating action on the blood, of which we shall learn more hereafter. This result is identical with that obtained by other investigators with amyl nitrite (Mayer and Friedrich, *loc. cit.*). It was further found that after giving a toxic intravenous dose, as above stated, the frequent, deep, and panting respirations gradually subsided into those of a slow, shallow character, which gradually diminished till death. This fact at once suggests that this last respiratory change is due to a depression of the respiratory centres, which is substantiated by our knowledge of the effect of an injection of an extremely large dose directly into the centres, when it was found that the respirations at once ceased. Wood (*loc. cit.*) believes that the cessation of respiration is due to paralytic asphyxia. I think it therefore just to conclude that the respiratory centres are primarily stimulated, and that this stimulant action is probably an indirect one, being due to the irritant action of the asphyxiated blood on them; and that secondarily the centres are paralyzed, death being due to this last action, unless it be dependent upon cardiac paralysis.

Conclusion.—*Respiration; Death.*

Potassium Nitrite: The respiratory centres are primarily stimulated, which is probably due to the irritant action of the asphyxiated blood; and secondarily depressed.

Death is due to a paralysis of the respiratory centres, when not dependent upon cardiac paralysis.

Amyl Nitrite: "Mayer and Friedrich assert that at first . . . . increases by stimulating the respiratory centres, ... later [Wood] the respiratory centres are depressed."

"*Death* from a failure of respiration."

The *blood* is peculiarly affected, and in so far as gross appearances are concerned, is indistinguishable from the blood of amyl nitrite poisoning, which has been described by Wood (*American Journal of the Medical Sciences*, July, 1871), Joylet and Regnard (*Gaz. Méd de Paris*, 1876), Gamgee (*Philos. Trans.* 1868, p. 589) and others, as having a dark uniform venous colour and a distinct brownish or chocolate shade. Gamgee is the only investigator who has made any special study of this action on the blood, and his work is so thorough and elaborate that it must be

accepted as correct. His experiments were not confined to the amyl nitrite alone, but embraced a study of nitric oxide and the potassium, sodium, and silver nitrites; and he finds that all of them act identically. A brief survey of his researches, which throw considerable light upon other physiological effects may be found in H. C. Wood's *Therapeutics*.

Dr. Wood (*loc. cit.*) says that "these researches have not, that I am aware of, been confirmed, but I think may be accepted as accurate. They do not, however, prove that the nitrite of amyl [or any other of the nitrites] entering the bloodvessel at once paralyzes the hæmoglobin of the blood-corpuscles and checks all oxidation. As already stated, the experiments of Dr. Gamgee showed conclusively that this new compound yields up its oxygen to reducing agents. Further, he found that when the nitrite blood was brought into contact with guaiacum-paper it still ozonized it, though not so actively as normal. It is evident that the blood-corpuscles retain to a greater or less degree their power of yielding up ozone to bodies desiring it; that they are capable of exerting at least this portion of their respiratory function; further, where this oxygen is given and the oxyhæmoglobin changed into hæmoglobin so far as our present knowledge goes, the hæmoglobin must absorb more oxygen before it can reunite with the nitrite. Evidently, then, absorption of oxygen must take place; evidently the blood-corpuscles must perform their respiratory function; but evidently, also, they are greatly crippled and impaired in the rapidity and ease of its performance. Hæmic respiration is, in other words, greatly interfered with, but not abolished."

And it therefore must follow that if the respiratory function of the blood be so seriously interfered with that the proper oxygenation of the tissues does not occur, and hence tissue metamorphosis must be checked. And, indeed, Wood further proves that the amyl nitrite must check tissue changes, because he found that the fumes of glowing phosphorus were completely extinguished by a few drops of the salt diffused in the air in the jar, and he therefore thinks that this checking of oxidation occurs within the body; further, that the elimination of carbonic acid was diminished; that the temperature was diminished; and because all the vital functions are depressed. Although I have no evidence of the action of the potassium salt on oxidizing phosphorus, or on the elimination of carbonic acid gas, yet I can testify to its marked action in diminishing the temperature, and to its general devitalizing influence exerted on the tissues.

Conclusion.—*Blood.*

The nitrites cause the arterial and venous to become of a uniform, dark venous colour, having a distinct brownish or chocolate shade, and that this is due to the conversion of the oxyhæmoglobin into a nitrite-oxyhæmoglobin; and that the nitrite blood possesses very little oxygen-absorbing power, and as a sequence hæmic respiration is seriously interfered with and tissue metamorphosis diminished.

The *temperature* record obtained after giving the potassium nitrite bears the same evidence of a profound action, as that obtained by experimentation with the amyl salt. Thus, Wood (*loc. cit.* p. 58) with amyl nitrite found in a pigeon the remarkable reduction of 14.5° F.; the average in the four experiments in these animals being about 7° F. In three

normal mammals (rabbits and cats) the average fall was equal to about 4° F. Wood makes no mention in any of his records of ever having seen any rise of temperature occur; yet Langendorf (*Berlin. Klin. Wochenschrift*, No. 43, 1874) and Mastin (*Wood's Therapeutics*, 1879, p. 350) both found a distinct rise of temperature in man preceding the depression. The former observer states that the average rise was equal to about .5° F., and Mastin found a momentary rise which was thought to be due to vascular dilatation. In two carefully conducted experiments on dogs in which the rectal temperatures were taken and the thermometer retained during the entire course of the observation except the last hour or hour and a half, a distinct rise occurred which was followed by a fall, although on an average this was not so great as that observed by Wood with the amyl nitrite, and it is possible that this is to some extent dependent upon the size of the dose. In my first experiment, the dog weighing 18.75 pounds, and the dose being 3 gram., the maximum rise amounted to .4° F., reaching this point three and a half minutes from the time of hypodermic injection; this was followed by a slow, continuous fall, the temperature reaching the normal eight and a half minutes later, and then gradually sinking for fifty-two minutes, when it reached 1° F. below normal; oscillating at this point for three-fourths of an hour, it then gradually began to rise. In the second experiment, in which a gram. was given to a dog weighing 22.5 pounds, the maximum rise amounted to .15° F., occurring five minutes after the time of injection; one minute later it reached the normal, and then sank gradually for two hours, when it was found to be 3° F. below the normal, at which point the temperature oscillated for about one hour, and then gradually returned to normal.

The results of these two experiments are given somewhat in detail because of the great interest centred in them, for in looking over Wood's experiments it seems apparent why he never noticed any rise occur, because he made his observations at relatively long periods after giving the doses, and in only one or two (?) instances was an observation made early enough to record any rise, and in one of these experiments (No. 36) the nitrite was given by inhalation, and the first record made one minute after administration showing the temperature unchanged; and in experiment No. 34, ten minutes after injection "into [the] breast," the temperature was "not as yet materially affected," it appearing probable from this that the thermometer was retained in the animal and watched. It also appears from the results of my own experiments above recorded, that the relatively smaller doses are more potential in causing the rise than are the larger ones, this corresponding to what has already been noticed by Langendorf (*loc. cit.*) in his experiments on man. It seems probable, as before suggested, that the rise was due to vascular dilatation, because it has been found that the potassium nitrite undoubtedly possesses the same power as the amyl nitrite in diminishing tissue metamorphosis. That the rise of

temperature was not so apparent after the larger doses, was no doubt because the effect of the vascular dilatation is overshadowed by the more pronounced action present in causing the depression. Wood states that the amyl nitrite causes a diminution of temperature because of an arrest or checking of tissue change, and in corroboration of this statement has experimentally determined that the depression is associated with a diminution in the elimination of carbonic acid, and further that if tissue metamorphosis is arrested, it must be associated with a general depression of all the functions, and this he asserts is actually shown to be the case, no matter in what way the drug may be exhibited, and being very decidedly manifest from the results of local applications, when it was well shown that the rapidity and completeness of the loss of function depended upon the amount of the adulteration of the poison. He further states his belief in the association of the central nervous system in the production of the depressed temperature. It has already been shown that potassium nitrite is a deoxidizer, and that the vital functions are depressed, and therefore if such is the case, there must be a diminution in the elimination of carbonic acid. That the nervous system is intimately associated with the diminished tissue metamorphosis in the production of diminished temperature, I have experimentally proven in three calorimetrical experiments with the potassium nitrite, in which it was found that heat dissipation was increased about two per cent. over heat production.

Conclusion.—*Temperature.*

Potassium Nitrite: The rise of temperature is due to vascular dilatation, and the fall to diminished tissue metamorphosis and an increased dissipation of heat.

Heat dissipation is increased about 2 per cent. over heat production.

Amyl Nitrite: "Rise of temperature . . . . evidently dependent upon vascular dilatation [and the fall of temperature] to a direct arrest or check of tissue changes or oxidation . . . . acts directly on the nerve-centres independent of its influence on the blood."

The functional activity of the *skeletal muscles* is impaired and ultimately abolished, although this last condition is never observed to occur previous to death, unless it result from a local application of the drug in a concentrated form for it has already been found that the skeletal muscles are the last portions of the motor system to succumb. In experimentally determining that the muscles were depressed, frogs were taken and the gastrocnemii muscles exposed, one of them was then painted with a solution of the potassium nitrite, and the other kept moist with salt water. After an interval of a few minutes it was found by comparing the two with an electrical current that the poisoned muscles rapidly lost their contractile power, and finally became completely paralyzed, although the uninjured muscles still retained their normal activity. The poisoned muscles also presented a pale appearance as compared with the others, but the reason of this I am unable to explain. Details of investigations, when the drug has been ad-

ministered through the medium of the circulation, have been given in previous pages.

Unstriated muscular tissue, excepting the heart muscle, is not as depressed as the skeletal muscles, although they are to a slight extent, as is shown by testing the muscular contractility of the intestines. The *heart*, unlike any other of the muscles, is primarily stimulated and secondarily depressed, for it was found, when it was isolated from the central nervous system in the mammal or excised in the frog, that when the drug came in contact with it, the pulsations were increased, and if the dose was sufficiently large, they subsided below the normal and finally ceased; the heart being arrested in diastole, remaining full of blood, and scarcely, if at all irritable. It has also been proven that in mammals both the diminished pulse rate and arterial pressure were due to cardiac depression. It has also been found that if the heart of the frog was excised, and a few fragments of the crystals placed on the ventricles, in a few minutes, the portions of the ventricles on which the crystals were placed became pale and depressed, and that when the ventricles ceased pulsating they remained in a pale systolic condition, although the auricles continued beating for a time, and were finally arrested in diastole, presenting a marked contrast when compared with the pale, systolic condition of the ventricles. This was evidently due to the strong local irritant action of the drug, since it only occurs after a local application of the drug in a concentrated form.

Conclusion.—*Muscles; Heart.*

Potassium Nitrite: The *skeletal* muscles are depressed and finally paralyzed. The *unstriated muscles* are depressed.

The *heart* is primarily stimulated, and secondarily depressed.

Amyl Nitrite: "After death the muscles preserve, though in an impaired condition, their functional power."

Absorption takes place very readily by any of the highly organized tissues, whether the drug be given by the stomach, hypodermically, or when locally applied. When placed in contact with the cutaneous surface an instance of the rapid absorption was well shown in frogs which had been placed in a saucer with a small portion of the solution in contact with their abdominal walls, when it was found that they jumped about violently for a few moments and then became quiet, passing into a narcotic condition which was followed by convulsions and death. Precaution was taken during the above observation to note that none of the solution was swallowed. Numerous instances of the very ready absorption by the different tissues have already been given.

Conclusion.—*Absorption.*

Potassium Nitrite: Absorption takes place very readily by any of the highly organized tissues.

Amyl Nitrite: "Can be absorbed by any surface except the skin."

The identity of the physiological action of the potassium and amyl nitrites has been so clearly demonstrated by the above investigations, that I was induced to make further experimental studies with the sodium nitrite. These investigations have not been carried out to such completion as to enable me to positively assert that its physiological action is the same as that of its predecessors, yet so far as these studies have gone—being confined entirely to the general action, circulation, and nervous system—the results all most positively indicate that its action is in all particulars parallel to that of the other salts. In looking over the literature of the nitrite, I have been unable to find any papers on the physiological action of any of the salts except the papers which have already been quoted on the amyl nitrite, and a single paper on the general action of ethyl nitrite by Richardson (*Brit. and For. Medico-Chir. Rev.*, July, 1867, p. 259). In comparing this last observer's results with the results of the above investigations made with the amyl and potassium salts, a remarkable similarity in the physiological action is very apparent, and indeed Richardson in his paper makes note of the close analogy with the amyl salt. In the human subject he found suffusion of the face, fulness and throbbing in the head, a frequent pulse, and rapid, panting respirations. In the lower animals it was found to be in no degree anæsthetic, sensibility and consciousness being maintained to the last; the arterial blood was found to be of a peculiar chocolate tint; and the animals after inhaling lethal doses died of a failure of the heart, or from a sudden cessation of both the pulse and respiration.

This brief review of Richardson's results is sufficient to show that the action of the ethyl nitrite is essentially that of the other salts, and the remarkable identity of the action of all of them when thus compared, at once suggests that their peculiar physiological properties must be dependent upon some one constituent entering into the composition of each and all of them, and it must be apparent that this one principle upon which this unity of action depends is *Nitrous Acid*. It is therefore fair to assume that all nitrites possess these distinctive physiological properties, which vary, however, in the rapidity, permanency, and potency of action, according to the base with which the acid is associated. In order to indisputably prove that these recognized properties of the nitrites are dependent upon the nitrous acid entering into their composition, it was intended to pursue a physiological investigation with the acid itself, but upon carefully studying the subject, such an investigation was found to be impracticable on account of the peculiar chemical properties of the acid, as it becomes very rapidly decomposed when brought in contact with water, or when subjected to a temperature of a few degrees above freezing point.

LABORATORY OF EXPERIMENTAL THERAPEUTICS,
UNIVERSITY OF PENNSYLVANIA, May, 1880.

ARTICLE XII.

CERTAIN TRAUMATIC LESIONS OF THE BONES OF THE ORBIT, WITH CARIES AND PERFORATION.

By CHARLES STEDMAN BULL, A.M., M.D., Surgeon and Pathologist to the New York Eye Infirmary.

CONTUSED or lacerated wounds of the margin of the orbit and immediate vicinity often cause serious results, among the most frequent of which are lesions of the supraorbital or frontal and infraorbital nerves, leading either to chronic neuralgia of the nerves and their branches, or to sudden blindness, either partial or complete. These results, being by no means uncommon, occur in the experience of the general practitioner, and therefore need no further reference. But wounds of this nature often cause inflammation of the periosteum and subjacent bones which may end in a carious process. Sometimes this does not immediately follow upon the injury, and the wound through the skin may slowly close and some time elapse before the signs of bone-disease develop. Though the death of the bone does not always follow these injuries, yet periostitis is the common result; and though the inflammatory process is generally localized, it may extend superficially as well as into the substance of the bone. The immediate consequence of a wound in this region is a rapid and marked swelling of the neighbouring soft parts, caused by extensive infiltration, and mainly into the eyelids, so that they cannot be opened; and this often renders it impossible during the first few days to tell whether the eye is injured or not. After the subsidence of the swelling the wound through the soft parts closes and all signs of the injury subside, unless inflammation has been started in the periosteum and bone, or the bone itself has been injured by the accident. If the latter, still the wound may close and then reopen, owing to a collection of pus upon or beneath the inflamed periosteum. When such an abscess forms and opens externally, it almost always results in a fistula, and the sinus is found to lead down to carious bone.

Fracture may result from these injuries, though this is rare, except in the ascending process of the superior maxillary bone. Fractures of the orbital plate of the frontal bone or in the inner wall of the orbit, involving the lachrymal and ethmoid bones, are occasionally met with, but here the injury is almost always the result of perforating wounds by direct thrust from some sharp or blunt-pointed instrument, and the bone itself is perforated. The danger from such wounds cannot be overrated, and one of the cases to be reported exemplifies this fact very markedly. Where the fracture involves the roof of the orbit, especially if there is a direct lesion of the bone caused by the instrument, the patient should be watched very carefully, and an unfavourable prognosis given. Injuries to the superior orbital margin or its vicinity, which do not involve the roof of the orbit,

are, on the contrary, often borne very well, even when caries is the result, especially in children, and this is true of pistol-shot wounds as of other injuries in this region. One of the cases which follow is an example of such an accident, in which the pistol ball remained imbedded for several months in the frontal bone, causing caries of the bone and an open sinus. Indeed, children seem to bear injuries of the soft parts and bones in this region exceedingly well. The reports of four cases which follow illustrate both the common and the rare forms of injury to the bones of the orbit, two of them being types of bone caries, and the others of perforating wounds of the bony walls, which opened into neighbouring cavities.

CASE I. *Lacerated Wound of Supraciliary Ridge and Orbital Margin.*—Patient was a boy, æt. 2; first seen January, 1878. Two months before, the child had fallen against the sharp angle of a box, and had received a wound along the orbital margin and supraciliary ridge, which had been about half an inch long. There was profuse bleeding at the time, and the neighbouring parts became rapidly swollen and discoloured. The lids were completely closed, densely infiltrated, and there was a great deal of pain. No physician was called in, and no special treatment had been carried out, except the application of cold water. The child at no time manifested any cerebral symptoms, but, after the subsidence of the swelling, the wound remained open, and there has been a more or less abundant purulent discharge ever since. On examination there was found a narrow fistulous opening through the skin and tissues of the left eyebrow at the junction of the middle with the outer third. This opening led down to the bone; the tissues immediately around it were retracted, sunken, and bound down firmly to the bone, and were covered by a thin yellow scab. There was no swelling around the fistula, but there was some tenderness on pressure. A probe introduced through the opening touched dead bone at once, and towards the median line could be pushed to the distance of half an inch, grating upon a roughened surface all the way, and apparently passing into a cavity, which would have represented the frontal sinus in an adult. Judging by the probe, the denuding of the bone from periosteal inflammation had not extended upwards much above the point of injury; but downwards, the probe passed along the orbital margin, and at one point passed beneath the arch into the cavity of the orbit, grating against roughened bone all the way. There was slight ptosis, but the child had apparently full power over the levator palpebræ muscle.

The child was etherized, the skin was made tense over the part by pulling the eyebrow upward, and a horizontal incision, an inch and a half long, was made parallel to the orbital margin, from just above the root of the nose outwards. The incision was carried through all the tissues down to the bone. After the bleeding had ceased, the lips of the wound were retracted, and a careful examination made of the bone. The periosteum was found either absent or diseased over a space about an inch long by half an inch wide, and the bone was roughened and carious for a corresponding space, involving the orbital arch, but not extending up on the forehead. Towards the inner end of the wound the carious process had extended more deeply into the bone, and here was a small cavity with several loose spiculæ of bone. By the aid of a stout pair of toothed dressing forceps and a sharp steel scraper, in shape something like a hoe, the cavity was cleaned out, the roughened and dead bone scraped off, and a freely-bleeding

surface left, from which it was hoped fresh granulations would spring up. The wound was then washed out with a one per cent. solution of carbolic acid, and filled loosely with borated cotton.

The case did well from the beginning. The dressing was repeated twice a day at first, as the purulent discharge was considerable; but later the wound was dressed only once a day. The cavity filled from the bottom with healthy granulations, and in three weeks from the operation the wound had entirely closed, the ptosis had almost disappeared, and the child was discharged from further treatment.

CASE II. *Pistol Shot Wound of Orbital Ridge and Margin.*—Girl, æt. 4, first seen in April, 1879. The mother said that five months before the child had been accidentally shot in the forehead just above the left eye, with a toy-pistol. The child fell, but did not lose consciousness. The wound bled very little, but there succeeded very violent inflammation of the soft parts, characterized by great swelling and redness, and the child cried constantly. A physician was summoned, who probed the wound, but could not find any ball, and then ordered poultices to be constantly applied. After about four weeks the active inflammatory symptoms subsided, and the child has not complained of any pain since then, but there has been a constant purulent discharge of offensive odour from the wound, and the mother states several small particles of bone, like grains of sand, have come away. An examination showed a fistulous opening through the tissues at the orbital margin near the inner end of the eyebrow. The opening was retracted and its lips pouted, the tissues around it for some distance were firmly adherent to the bone, and there was a moderate amount of ptosis. The orbital margin and tissues over it were thickened, and thin pus oozed from the fistula. A probe introduced, passed along a fistulous tract inwards toward the nose, and downwards along the orbital margin, touching roughened bone along its course. The carious process did not seem to extend outward towards the temple beyond a very slight degree. In pushing the probe inward, a point of bone was felt that appeared to be very loose, and here there seemed to be a small cavity into which the probe entered.

The child was etherized, and a horizontal incision was made parallel to and just above the orbital margin, extending from the median line at the root of the nose to a point at the junction of the inner with the middle third of the eyebrow. The incision was carried through all the tissues, including the periosteum, down to the bone. The bleeding was quite free, and seemed to come quite as much from the bone as from the soft tissues. After it had been somewhat checked a careful examination was made of the diseased bone. The periosteum was in places entirely absent, in others perforated by a number of small openings. Several small grains of dead bone were removed with the finger, and the bone was then scraped smooth with the instrument used in the first case. At a point midway between the ends of the incision was seen the opening of another fistula, and here was a small spicula of bone projecting, which was movable. The opening was enlarged by a strong pair of dissecting forceps, and then the small sequestrum was removed. Its removal left a small cavity, pointing towards the median line, with something dark at the bottom. After one or two fruitless attempts to grasp this, it was seized with a pair of sharp forceps and brought out and proved to be the pistol ball, about the size of a small buck-shot, somewhat roughened and eroded. The cavity was then washed out, carefully scraped clean, and again syringed, and when examined

proved to be fully a quarter of an inch deep, and extended towards the median line. This case was treated exactly as the preceding one; the cavity was washed out twice a day with a one per cent. solution of carbolic acid, and then filled loosely with borated cotton. The reaction from the operation was quite severe, and the parts swelled ominously, but a careful and constant application of cold cloths, and keeping the wound open, soon caused these symptoms to give way, and the process of repair and filling up of the wound went on in a satisfactory manner. At the end of the fifth week the wound had entirely closed over and cicatrization began. The tissues have since become firmly adherent to the bone, and there is a tendency to a retraction of the scar, so that it may be necessary later to detach the cicatricial mass from the underlying bone and maintain the separation of the two surfaces until each has healed over. This of course must be done subcutaneously, the object being to allow greater freedom of motion to the skin and subcutaneous tissues. The ptosis, which has remained about the same as before the operation, would probably also be improved by this detachment of the cicatrix, provided it could be so maintained.

In both these cases, though the degenerative process in the bone had lasted two and five months respectively, the periosteum overlying it was not entirely destroyed. It was perforated by numerous openings over a somewhat circumscribed area, and its condition partially concealed by the fleshy granulations which covered its surface and also by the sinuosity of the fistulous channel. The circumstances account for the fact that it is not always easy to recognize the extent of the carious process in these cases, and sometimes not even its precise situation.

The bone disease in this region, according to the statements of authorities, consists in a slow molecular destruction, so that the detritus is finely granular and concealed more or less by the purulent discharge. It is rare to find sequestra of any size, and the elder *Sichel*, whose experience in this disease was quite extensive, never met with a case in which a piece of dead bone was so large as to require removal by the forceps.

The adhesion of the lips of the fistula to the underlying bone interferes with the free movements of the soft parts, and if this adhesion of the soft parts extends for some distance beyond the fistula, it may interfere with the movements of the lids and even lead to ectropium. The latter danger is especially liable to occur in the lower lid.

In the second case, where the original injury had been caused by a pistol shot wound, it was impossible to obtain any exact information from the patient's family as to the manner in which the accident happened. But the shot must have been fired from some distance, as the ball was of such a size as to have perforated the frontal bone and entered the cavity of the skull, if the pistol had been discharged near the patient. As it was, the original injury together with the resulting caries produced such destruction of bone tissue as to come uncomfortably near the cranial cavity.

CASE III. *Pre-lachrymal Abscess; Caries and Perforation of the Lachrymal Bone of Traumatic Origin.*—Boy æt. 14, first seen Sept. 1,

1879. About four months before he had received a blow from the end of a cane at the inner angle of the left eye, which lacerated the skin and caused a free hemorrhage. The parts swelled and became very much discoloured; but cold applications reduced the swelling in a few days, the wound healed in the skin, and nothing more was thought of the injury, until the boy began to complain of a dull pain along the side of the nose and inner angle of the upper lid, and a swelling began to appear in the same region. This increased somewhat rapidly in size, the skin became very much thinned and distended, and finally the abscess broke, and a large quantity of pus was discharged. This occurred about a month after the injury, and a purulent discharge has continued ever since, a period of three months.

When brought to the writer for treatment, there was a swelling about the size of a hazel-nut at the inner angle of the orbit and side of the nose, the skin was somewhat reddened over it, and there was a small fistula through its anterior wall, from which there could be pressed out a small quantity of thin pus. The swelling involved the inner end of the upper lid, and was limited below by the internal canthal ligament. It was slightly resistant, but could be pressed back against the bony wall without much force. When the pressure was removed the swelling returned, as if its cavity had been refilled; and as very little pus could be evacuated, it seemed possible that a volume of air kept the cavity distended. A probe was introduced through the fistula, and almost immediately struck dead bone, and on passing the head of the probe over the roughened bony surface it suddenly slipped into a somewhat deep cavity, which seemed to have large dimensions. A diagnosis was made of caries of the lachrymal bone, and possibly also of the ethmoid bone, with a defect in the bones, which was either the direct result of the injury or a secondary result of the carious process, with the probabilities in favour of the former view. It was decided to make an exploratory incision through the external swelling down to the diseased bone, in order to determine how far the diseased process extended. The patient was etherized, and a straight incision made across the swelling a little to the nasal side of its vertical diameter reaching from the orbital margin of the frontal bone down to the internal palpebral ligament. The subcutaneous connective tissue and fascia were found very much thickened, and the contained cavity of only small dimensions. After the free hemorrhage had been somewhat checked, the cavity was washed out with a one per cent. solution of carbolic acid, and the lips of the incision being held apart by retractors, a large hole was found at the bottom. This hole pierced the lachrymal bone just behind the crest, was irregularly circular in form, and about a third of an inch in its longest diameter which was horizontal. It involved the orbital plate of the ethmoid bone, and opened into the ethmoid cells. A probe introduced through the hole, having been previously bent upon itself nearly at a right angle, passed inwards and backwards without meeting with any obstruction. When pressed downwards it passed easily for about half an inch, but was then arrested by a firm bony obstacle. An attempt was made to pass a drainage wire from an opening in the lachrymal bone into the nose, but failed. Further interference was deemed unadvisable at that time, and the hole and cavity being carefully syringed out with the same solution of carbolic acid, the wound was loosely filled with borated cotton, and the patient allowed to recover from the anæsthetic. There was very little reaction from the operation, but when the wound came to

be dressed on the next day, the patient complained that the fluid used in washing out the cavity ran down into his nose, and that he could taste the carbolic acid. The solution was then changed to one of borax, a drachm to the quart of water; and when the patient sat up in bed the fluid could be seen slowly trickling from the nose, showing that the cavity in the ethmoid cells communicated with the nose.

The purulent discharge from the wound was not very marked, and the cavity leading down to the hole in the lachrymal bone has slowly contracted, but there is apparently no attempt as yet at closure of the bony defect. When the patient expires with closed nose and mouth, air and mucus are forced out of the hole, but only in small amount. This shows that, though a communication exists with the nasal cavity, it is not a direct one, and probably not a large one. At the present writing, three months and a half after the operation, there is a small fistula leading down to the hole in the lachrymal bone, which is somewhat nearer the orbital margin than the opening before the operation was. There is also a slightly retracted appearance of the cicatrix, but not enough to interfere with any movement of the upper lid. There has been no purulent discharge from the opening for a number of weeks, and only occasionally does a drop or two of clear, watery fluid exude from the fistulous tract. There is no deformity; the scar of the operation is almost invisible, and it has seemed to me best to leave the case as it is, without any further interference, unless something unforeseen should occur.

In this case there was never at any time any interference with the passage of the tears from the conjunctival cul-de-sac to the cavity of the nose, showing that the disease was not in the tear passages. This prelachrymal abscess connected with the carious bone at the bottom, might have been mistaken for an abscess of the lachrymal sac, if examined carelessly. But the fact that there was no obstruction to the flow of tears into the lachrymal sac, together with the other fact that the swelling was above the internal palpebral ligament, and a little external to the region of the lachrymal sac, rendered the diagnosis certain. Another point against its being anything like dacryocystitis was the small amount of pain experienced by the patient, even on pressure, and the absence of all the usual signs of acute inflammation.

Very recently there have been reported two cases of this rather rare accident by Dürr in the *Klinische Monatsblätter für Augenheilkunde* for September, 1879. The case occurred in a man æt. 40, who, fourteen years before, had received a blow from the point of a rapier at the internal angle of the orbit. There was a hard, firm tumour above the internal palpebral ligament. After opening it, nasal mucus flowed out, and a round hole, six millimetres wide, was seen in the lachrymal bone. The case was treated by syringing, cauterization, and the introduction of a drainage tube through the hole into the nasal cavity, and eventually the defect in the lachrymal bone entirely closed, though the external fistula remained.

The second case was in a man, æt. 62, who had been wounded thirty-four years before by a foil in the inner angle of the right eye. The swelling had made its appearance only eight months before, and was limited

below by the internal palpebral ligament. By firm continued pressure the tumour could be made to disappear. A hole could be felt in the bones through the skin, involving the orbital margin of the frontal bone as well as the lachrymal bone. It was a rounded oval, its horizontal diameter being 1 cm. long, and its vertical 12 mm. No operation was attempted in this case.

CASE IV. *Lacerated Wound of Upper Lid and Orbit; Perforation of Orbital Plate of Frontal Bone; Meningitis; Death.*—The little patient was a boy, æt. 18 months, and was first seen by the writer in April, 1878. On the previous day, while tottering along the floor with a wooden clothes-pin in his hand, he stumbled and fell, striking with the left eye upon the pronged end of the clothes-pin. There was some bleeding from a wound in the lid, but nothing of an alarming character. The child cried all the rest of the day and part of the night, but towards the morning of the next day he became quiet, and remained in a somnolent condition until I saw him, making no noise or complaint except when disturbed. When called to see him, he was lying on his mother's lap, perfectly quiet, with blanched face, bloodless lips, and a very thready pulse; but when any movement was made to disturb him, he gave vent to a whining, fretful cry, which lasted until again left undisturbed. The eyelids were much swollen, particularly the upper one, and discoloured from extravasated blood. About the middle of the upper lid was a small lacerated wound, through which projected some orbital fat, and from which oozed a thin, bloody discharge. It was impossible to open the lids, owing to their infiltrated condition, and hence the state of the eye could not be ascertained. The projecting mass of orbital adipose tissue was carefully pushed back through the lid, and a probe was then introduced and passed back into the orbit for about half an inch. At one point in the roof of the orbit a rough object was felt, which gave the impression of a foreign body, and the condition of the clothes-pin was then inquired into. The mother could not tell whether a piece had been broken off or not. The wound in the lid was then enlarged, and a pair of forceps introduced, in order, if possible, to grasp the supposed foreign body and remove it. With the forceps the same rough object was felt, but a doubt was raised whether it was not the edge of a fracture in the orbital plate of the frontal bone. Nothing distinctly protruding into the orbit could be felt, and in view of the extreme delicacy of the bones in this region in so young a child, it was not deemed advisable to extend the operation any farther. The parents were warned of the dangerous nature of the accident, and of a probable fatal termination. The next day the somnolence deepened into semi-coma, the pulse became very slow, the surface of the body clammy, and the pupil of the other eye contracted. These symptoms became more marked, the coma became profound, the pupil dilated, and death resulted on the fifth day. I omitted to state that at the time of the examination of the wound, no loose bone was anywhere discovered.

The *post-mortem examination* showed extensive serous effusion under the arachnoid, and in the meshes of the pia mater, all over the convexity of the left hemisphere, and at the base. The ventricles were somewhat distended, though not markedly so. The base of the left anterior lobe was the seat of an abscess, about as large as a walnut; and there was entensive meningitis, reaching back nearly to the occipital lobe on the left side. When the brain was removed there was uncovered a ragged hole through

the roof of the left orbit, about midway between base and apex, which connected with the opening in the lid, as a probe passed through the lid entered the cavity of the skull through this hole. There was no trace of any foreign body, though it was carefully looked for. One of the prongs of the wooden clothes-pin had evidently fractured the vault of the orbit, and had entered the cavity of the skull, causing meningitis and abscess of the anterior lobe. The pin had not been broken off in the skull, but had been withdrawn entire, thus leaving the wound uncomplicated.

Of course, the roof of the orbit, from its situation and extreme thinness, is especially liable to such injuries. The external wound in this case was of trifling extent, and in itself would have excited little suspicion of danger. There was very little hemorrhage, most of which seemed to come from the lid; for when the skull was opened, and the brain removed, there was no blood in the cranial cavity, and scarcely any in the orbital tissue.

There were no convulsions in this case, and no symptoms appearing in the eyes, except the change in the size of the pupils.

A careful examination was made of the orbit, but there was no foreign body to be found, though there was considerable infiltration of the tissues by plastic effusion.

These perforating wounds of the orbital walls are serious, and when the roof is fractured, death usually results.

47 EAST TWENTY-THIRD STREET, Jan. 15, 1880.

ARTICLE XIII.

ON VACCINATION. Communicated by WALTER F. ATLEE, M.D., of Philadelphia.

IN the number of the *Practitioner* (London), for January, 1880, is an article by Henry Stevens, M.D., of the Medical Department of the Local Government Board, entitled "On the Supposed Deterioration of Humanized Vaccine Lymph in this Country, *à propos* of the question of 'Animal Vaccination.'" In this article Dr. Stevens says that he believes that he has examined more vaccinated children than any man alive or who ever lived. He finds no ground whatever for the suspicion that the present arm-to-arm lymph has lost its true and original Jennerian character. He denies it altogether. He says: "I can positively state that, examining dozens of recently vaccinated children every day of my life, and that during a long series of years, I find no ground whatever for the suspicion that the present arm-to-arm lymph has lost its true and original Jennerian character. I do not believe that our arm-to-arm lymph affords any less protection than it ever did." He says, moreover, that it was his duty to

inquire into nearly all the complaints of the untoward results of vaccination, and can state most positively that he never found in any one single instance any ground whatever for these allegations against vaccination.

I wrote to my father, Dr. Atlee, of Lancaster, of these statements of Dr. Stevens, and in his answer he says: "I fully agree with Dr. Stevens that there has been no deterioration in the vaccine virus, nor in its effects, from the time of my experience with it, which has now been sixty-four years. While a student in 1818–19, the varioloid made its first appearance after the introduction of vaccination, and I was then extensively engaged in vaccination and re-vaccination. I studied the *disease* and its effects, so far as the pustule was concerned, with extreme care, and I *now* find no difference in its appearance or in its preservative effects from what they were at that time."

My father adds: "I have in almost all instances used the crust. Sometimes have punctured the vesicle and taken the lymph on glass. In a few, very few, instances among the thousands I have vaccinated, taken from arm to arm. But I never could perceive any difference, and I believe that one is no better than the other, each producing all the well-marked diagnostics of genuine vaccine pustule.

"I have tested the efficacy by inoculating for smallpox after vaccination; have taken patients after vaccination to cases of malignant smallpox in small and hot stove rooms, and exposed them to the foul atmosphere for fifteen or twenty minutes, secure from danger. In one case of a mother with six unvaccinated children, one at the breast, who had a severe attack of smallpox, as soon as I discovered the nature of the case, I vaccinated all the children from a vaccine-crust, and they all took the vaccine disease. The room—it was in February—was a small ten-by-twelve feet room, with a hot ten-plate stove, and but one bed, on which they all slept, and which was saturated with smallpox contagion; yet these children picked off the scabs from their mother's body, and the baby nursed at her breast, and no one took the smallpox. Had I time this morning I could multiply instances of a similar kind. I have the utmost confidence in the protective power of vaccination, and I feel very sure that the cases of failure are very much more attributable to the use of vitiated vaccine matter; to the ignorance of unprofessional persons as to the purity of the virus, who have practised vaccination; and, in my experience, to the carelessness of physicians themselves as to the condition of the patients vaccinated, when affected by hepatic or other eruptions, than to any inefficiency of genuine vaccination."

"I have been very careful myself, and have enjoined it upon my students and younger professional brethren, never to use a crust taken from an *unclean* child; nor, unless the extreme urgency of the case demanded it, to vaccinate a child affected by any eruption. It is the only way in which that foul disease, smallpox, can be exterminated."

ARTICLE XIV.

CARBUNCLE OF THE FACE. By F. A. BURRALL, M.D., of New York.

THE face is not a usual seat of carbuncle, but when occurring there it assumes features of more than ordinary interest, and requires prompt and careful attention. The lip is generally but not always the part affected. Bryant[1] says that the disease "was probably first described by a clever young surgeon, Harvey Ludlow (*Med. Times and Gazette*, Sept. 1852), and M. Reverdin, interne des hôpitaux, has given an elaborate essay on the subject in the *Archives Générales de Médecine* of August, 1870. These are his conclusions:—

"1. Anthrax and carbuncle of the face present a special gravity.
"2. This gravity is due to the ready complication with phlebitis.
"3. The facial phlebitis is attended with death, either by extension to the sinuses of the dura mater, or by becoming the source of purulent infection.
"4. Of anthrax of the face, that of the lips is more frequently complicated with phlebitis than the others. This may be explained by the peculiar texture of the lips.
"5. Anthrax of the lips has nothing in common with malignant pustule.
"6. The involving of the orbit in the phlebitis, as demonstrated by exophthalmia, shows almost certainly the implication of the sinus.
"7. Incision, speedily and extensively performed, seems to be the best means of preventing, and sometimes of arresting the phlebitic complications."[2]

Billroth writes:—

"Unfortunately, I have had such sad experience in these carbuncles of the face, that in any affection of the kind I am very solicitous about the life of the patient."

Thus much by way of preface to a case of this disease which I attended last year, and which, apparently of minor importance in its commencement, caused me much anxiety during its course.

CASE.—Jan. 28. I was called to see Mr. A., an American, 20 years of age, a clerk, somewhat delicate in appearance, and of strumous antecedents, and was told that he had not been feeling well for some time. He had had a chill on the 24th, and woke up saying that his face was "all swollen up." Pulse 88, temp. 100°. There were one or two acne-like pustules near the left angle of the mouth. The constitutional disturbance being only moderately severe, I ordered the tincture of muriate of iron internally, and externally the lotion of lead and opium.

29*th*. The swelling of the left side of the face, which had been slight, has increased. Pulse 86–88. As there had been no movement from the bowels, an injection was ordered. The intellect is clear. Poultices of flaxseed were substituted for the lotion of lead and opium.

30*th*. There is a longitudinal swelling like the half of a date-pit running downwards and outwards from the left angle of the mouth, which I incised, and found carbuncular. Pulse 96, temp. 104½. I changed the dressings, substituting oakum wrung out of warm water and covered by oiled silk, the parts being also smeared occasionally with Peruvian balsam. Patient ordered to take as much milk as possible, and beef-tea occasionally. P. M., pulse 106, temp. 104. The chin is flecked with small pustules,

[1] Practice of Surgery, Phila., 1879, p. 136. [2] Ibid.

and is very tender and brawny, as is also the left submaxillary region, which is swollen, as if from glandular enlargement.

31*st*, A. M. Patient passed a restless night. Has diarrhœa. Pulse 104, temp. 103. The swelling is somewhat less, and the incisions permit the exit of discharge. P. M. Pulse 109, temp. 105. The left two-thirds of the lower lip being infiltrated with caseous material, I drew a bistoury through the lip laterally, posterior to the vermilion border. Little hemorrhage followed, but he felt relieved. Some diarrhœa. He has been taking ten-drop doses of Squibb's liq. opii comp. p. r. n. to relieve his discomfort and quiet his nervous system, which is very irritable. As he has some pain in the chest, I examined the right side, but detected no unusual respiratory sounds. Urine showed a dense pinkish sediment, and an acid reaction. Spec. gravity, 1030. No albumen, no glucose (Moore's test), no phosphates. The microscope revealed urates. Continue treatment.

Feb. 1, A. M. Pulse 96, temp. 103¾. Had a temporary delirium (the brain is naturally excitable), accompanied by an hallucination. The swelling is less. He had three or four passages during the night. At 2 P. M. I found the lip and face presenting the usual tumefaction. Several lines of lymphatics, distinct by their redness, ran along the anterior portion of the throat to the upper part of the chest. These and the throat I painted with tincture of iodine, and afterwards applied it to the chin. Ordered quinæ sulphat. gr. xxiv, acid. sulph. dil. gtt. xxxvj, syrup. limon. ʒij. M. S. ʒj every three hours. Continue tinct. ferri muriat. P. M. Pulse 116, temp. 103½. Continue treatment. I also directed a cloth wet with a solution of carbolic acid (ʒj–Oj) to be laid upon the lower lip to protect the upper from it. There has been a constant expectoration of tough mucus. Patient takes nourishment hourly.

2*d*, A. M. Pulse 103, temp. 104. There is less swelling. The slough is separating from the lip. P. M. Pulse 104, temp. 104¾.

3*d*. The lip is still swollen, the chin less brawny. Pulse 98, temp. 103¾. There is less discharge from the wound, and the lip is assuming a healthier aspect. The diarrhœa has improved. The acneform pustules which were scattered upon the chin have almost disappeared, and the expectoration is less bloody. The right side of the face has not been affected.

4*th*, A. M. Pulse 98, temp. 103. From five or six "pepper-pot" openings on the anterior aspect of the chin there is an exudation on pressure of thick purulent material. A free longitudinal incision gave vent to pus, and showed the cellular tissue to be undermined—a probe passing upwards to near the vermilion border of the lower lip. As the submental region was indurated and discharging pus, I also made an incision there of about an inch in length. The throat being tender to the touch on the left side as far down as the clavicle, I painted it with tincture of iodine.

6*th*. Pulse 84, temp. 101½. A linear induration resembling a plugged vein or lymphatic has appeared upon the throat to the left of the median line which interferes with the extension of the head. The sputum is frothy and sanguinolent. An examination of the chest posteriorly revealed rude respiration without prolonged expiration. Bronchial râles, both subcrepitant and large, diffused over the lungs.

12*th*. Has improved steadily; the lip is resuming a natural appearance, and there is no discharge from the chin. Patient taking porter and cod-liver oil in addition to the tinct. ferri muriatis.

14*th*. Respiration 48. Percussion dull over the lower third of the anterior thoracic wall. No bronchophony. Respiration is exaggerated over the upper two-thirds of the chest, and diminished or feeble over the

lower portion. Posteriorly percussion is dull over upper and lower third of the chest. Respiration exaggerated over superior part, feeble or absent over lower fourth. Expiration not prolonged. On the right side are subcrepitant râles. Expectoration is diminished, but still bloody. In addition to other remedial measures I have recommended him to practise deep respirations, while his body is bent forward, resting upon his hands.

March 12. The improvement is continuous. To relieve the cough I have applied to the larynx a powder consisting of pulv. tannin., sacch. alb., āā ʒij, morphia muriat. gr. x. An examination showed pallor of the soft palate with a grayish and somewhat elevated ulcer near the right tonsil. The tonsils are small, pharynx reddish and venulated. Epiglottis of medium thickness, with congestion of posterior surface, enlargement of inter-arytenoid commissure. The great irritability of the pharynx interfered with satisfactory examination of the intra-laryngeal region. Supporting treatment was continued as long as the debility of the patient made it necessary. Accompanying this treatment, and a change of air, there was a gradual restoration to health.

I think this case illustrates the necessity of giving careful attention to any appearance of carbuncle upon the face, since its beginnings are comparatively so benign, when compared with the dangers which develop during its course. As has been said, the serious element of the disease appears to be a tendency to septicæmia the result of absorption. There can be little doubt as to the necessity of early support. My patient suffered considerably from headache, and I feared that the steady use of iron might have induced it, but looking upon the inflammation present as one of a low character, allied to erysipelas, and considering the muriate of iron as of much use in that disease, I concluded to continue the remedy, and I think with decided benefit. I have also at other times, as in this instance, found oakum, wrung out of hot water, and covered with an impervious dressing, such as oiled silk, a most excellent application, the carbuncle, or such incisions as are made necessary, being first filled with Peruvian balsam. This dressing is light, antiseptic, and absorbent.

With regard to incisions it seems to me that they should, as a rule, be limited by the indurated margin of the carbuncle. Made thus far, they relieve tension and facilitate the expulsion of sloughs. If more extensive, they produce pain and unnecessary hemorrhage, and perhaps open avenues for purulent absorption.

In singular contrast with the above case was that of a gentleman of over seventy whom I had under my care at the same time suffering from a small carbuncle upon the left upper eyelid. The glands of the neck were enlarged, but the pulse was only 72 and the temperature 100. A carbolic acid lotion (ʒj–Oj) was applied to the swelling, the tincture of the muriate of iron was given in ten-drop doses, and the patient convalesced in a few days. There was almost complete absence of constitutional disturbance.

Every physician appreciates the difference between those diseases which attack the patient promptly and openly and those which, as it were, crouch for awhile before making a deadly assault. To this latter class belongs carbuncle of the face, and it needs careful watching from the start.

REVIEWS.

ART. XV.—*Anæsthetics: their Position and Prospects.*

Deutsche Chirurgie; herausgegeben von Prof. Dr. BILLROTH in Wien, und Prof. Dr. LUECKE in Strassburg. Lieferung 20. Dr. O. KAPPELER: *Anæsthetica;* mit 18 Holzschnitten, 105 Curven in Zinkographie und 3 Lithograph. Tafeln. Stuttgart, 1880.

Anæsthetics. By Dr. O. KAPPELER; being Part XX. of "*German Surgery,*" conducted by Profs. BILLROTH and LUECKE.

Three Reports on the Action of Anæsthetics to the Scientific Grants Committee of the British Medical Association. British Medical Journal, Jan. 4 and 24, and June 21, 1879.

The Advantages and Accidents of Artificial Anæsthesia: A Manual of Anæsthetic Agents. By LAURENCE TURNBULL, M.D., Ph.G., Aural Surgeon to Jefferson Medical College Hospital, etc. 2d ed., revised and enlarged. Philadelphia: Lindsay & Blakiston, 1879.

THE most appropriate time for the consideration of a scientific subject is when some great advance has just been made, which places it in a changed and new position, or when doctrines have been, by long study and experience, so firmly established that they meet with general acceptance, and promise, at least for the near future, something approaching stability. It is needless to say that the present is not such a period in the history of anæsthetics. On the contrary, we find that in regard to one, chloroform, confidence is most thoroughly shaken, the practical disadvantages of ether are daily felt and lamented, while the frequent resort to various combinations of these, and the new agents which are being brought forward to supplant the others, are evidence of the unsettled state of professional opinion and the unsatisfactory condition of the subject.

But widely different as is the position of the subject from what we would desire, some good may result from a general consideration of it. Possibly, extreme views may be moderated, conflicting opinions disposed to harmonize, or, if not, it is something to look over past progress and see just where we are standing, what is the outlook ahead, and try to make preparation for possible further advance.

The appearance of the books whose titles are placed at the head of this article affords us an opportunity to make such an attempt. Dr. Kappeler's deserves the first place from its completeness, its accuracy, and its thorough scientific character. It will be noted that no title is attached to the author's name, and nothing indicates an official position. But his qualification is guaranteed by the work being one of a series, which, as a whole, is to present German surgery by the best German surgeons. In the list of authors we find such names as Billroth, Breisky, and Bruns, Esmarch, Hildebrandt, Nussbaum, Thiersch, Volkmann, Winckel, and many others equally well known. The student will not proceed very far in the book before he will discover that its author needs no indorsement

from any one. His actual experience with chloroform is stated at "about 5000 administrations," but the careful study devoted to the subject is shown throughout, and especially in the sphygmographic tracing taken during anæsthesia, even during the early stages, a period presenting great difficulties, and in the careful noting of all the physiological facts attending every step of the process. Dividing the subject into general and local anæsthesia, he has treated it after the methodical and exhaustive manner of his countrymen. The bibliography occupies nearly seven pages, and includes much of the journal literature of this country and of Great Britain. In regard to the chemistry of anæsthetics, the physiology of anæsthesia, practical experience with other different compounds, and full presentation of all information upon the subject, the work must be considered complete up to the date of its publication.

The reports of the committee noted at the head of this article, brief as they are, form one of the most valuable contributions of recent times to the study of anæsthesia and anæsthetics. We could not expect less than work of high scientific character and practical value from a committee[1] appointed by the British Medical Association to investigate so important a subject. It is true that the ground gone over is not large in amount, but it has been thoroughly worked, and, as a consequence, has yielded well. The committee followed two lines of inquiry: first, to discover wherein lies the special danger of chloroform; second, to try if some anæsthetic agent could be found which would avoid these dangers. Distinct subjects of study were: the changes produced in the gases of the blood, the changes in the gases of respiration, and the effect of anæsthetics on the nervous condition and on mental phenomena in man. These investigations have been made by experiment upon animals, with the most approved instruments of precision, and with careful observation of every occurrence. The manner of experiment is important. The trachea of the animal was opened, and respiration carried on artificially, at the same time the sternum was removed, and the heart thus submitted to visual observation, while the blood pressure in the arteries was marked by the sphygmograph. Thus anæsthetic vapours could be added to the air inspired without any irritant effect upon the upper air passages, thus the different effect of different vapours upon the circulation was apparent, and in some instances was striking, and thus respiration was separated from the circulation and the effect of the vapour upon each of these great functions could be observed and studied while carried on independently of the other.

We regret that we cannot speak of Dr. Turnbull's work in terms of equal praise. It is a book having in many respects great merit, but having also most serious blemishes, faults, and errors, which the appearance of this, the second edition, afforded an opportunity of removing and correcting. The author has succeeded very well in attaining the objects in view, as stated in the preface of the first edition, of presenting the description, the chemistry and chemical tests, and modes of administering anæsthetics, together with his personal experience with them and the mortality resulting from their use. He has produced a treatise containing a large amount of valuable information which the student and practitioner will find difficulty in procuring elsewhere, but this information is not methodi-

[1] The committee consists of Joseph Coats, M.D., Pathologist, Glasgow; William Ramsay, Ph.D., Assistant to Prof. of Chemistry; and John G. McKendrick, Prof. of Physiology, University of Glasgow.

cally presented or well arranged for either pleasant reading or profitable study. Were this all, there would be but little ground for complaint, but, unfortunately, the book contains serious errors and careless statements, and upon some points there is shown a spirit of unfairness, which must seriously interfere with its claims to be considered a scientific treatise. Some of the blemishes would not exist, and some of these serious charges could not have been made, had there been more careful proof reading. It is not satisfactory to read of Budin and Coyne's studies of the pupils in anæsthesia as studies of the pulse, and we imagine that Dr. Culbertson, of Ohio, although he may overlook the misspelling of his name, will not relish the presentation of his prize essay as the "*Sin* of Anæsthesia in Midwifery" instead of the "use"! Again, such statements as those on pp. 208, 224 should have attention called to them because positively dangerous! One is that chloral hydrate should be given with great care [!] to little children in doses of *three grains for each month!* The other, that a friend of the author has used "with success," in the obstinate vomiting of pregnancy, chloral in two-drachm doses, repeated in an hour or two if necessary! It may be inferred that the administration is to be by enema, but it is not so said, and even then, the dose stated is far too large without a word of caution being added. We regret to find, and to be obliged to call attention to these disagreeable features in a book which, with a little more care and attention, might have been a treatise of high character.

The two leading anæsthetics have experienced, since their introduction, wide variations of fortune. Chloroform, the discovery of which followed so closely upon the use of ether for anæsthesia, received a hearty and enthusiastic welcome. Its power, its certainty, the rapidity of its action, its convenience for the surgeon, and its lack of unpleasant characters for the patient insured its reception everywhere as a substitute for ether, and almost banished the latter from practice. But the dark feature of chloroform, its danger, very soon made its appearance, and able and influential advocates demanded the reinstatement of ether to its former place in professional favour. In two cities, Boston and Lyons, the change was immediate and thorough. In the former, where chloroform had never, probably, obtained the footing it had elsewhere, its use was entirely abandoned by 1853. In the latter, Diday and Petrequin opened the campaign in favour of ether as early as 1849, prompted by some fatal accidents from chloroform. The force and persistence with which the attack was carried on by the Lyonnaise, and the fact that Paris and other cities continued to adhere to chloroform, made the two anæsthetics subject of more polemical discussion, and of greater diversity of opinion in France than in any other country. Sedillot, of Strassburg, entered the field with the dogmatic proposition that "pure chloroform, well administered, never kills," and under the leadership of Malgaigne, the Paris Academy of Medicine declared, but not without dissenting voices, that with the observance of certain precautions, chloroform was entirely harmless. Velpeau, however, testified before the courts that chloroform might cause death, even when administered with the greatest caution. Yet the Surgical Society of Paris declared, in 1859, that ether could not take the place of chloroform because its narcosis was stormy, and entire muscular relaxation was not caused by it, unless pushed to a stage in which life was in danger. This brought from the medical Society of Lyons a counterblast; ether was declared to be innocuous, and its narcosis as perfect and as deep as that of

chloroform. In 1866–7 Petrequin renewed the war against chloroform, and urged the fact that during fourteen years' exclusive use of ether in Lyons no death had occurred. In reply, Velpeau advanced his large personal experience with chloroform without an accident, and Sedillot again entered the field, his motto now modified, however: "the use of chloroform is not without danger, but it may be avoided by care, experience, and skill." In 1867 Laroyenne, of Lyons, published a fatal case of etherization, and six other cases were collected by Gayet, and although they would not all bear critical examination, they served to show that ether was an agent not altogether devoid of danger; the strength of attack of the Lyonnaise school was broken, and in France ether has never succeeded in supplanting chloroform.

In Great Britain, chloroform was, for the first decade and a half after its discovery, almost the sole anæsthetic used; ether had a few adherents, men of high character and standing. Edinburgh especially led in devotion to her native anæsthetic, and, like Sedillot's terse statement, that chloroform "*ne tue jamais*," the sententious doctrine of Syme and Lister, that "a case for operation is a case for chloroform," had a wonderful influence, as all such dogmatisms have. Soon after 1870, however, the tide began to turn in favour of ether. The change of current is attributed by Dr. Kappeler, to whom we are indebted for the facts of this historical sketch of the subject, to three facts: First, the increasing number of deaths from chloroform, and the enterprise of the British journals in placing these unfortunate cases before the profession, even to their minutest particulars. Second, the influence of Dr. Joy Jeffries, of Boston, at the Ophthalmological Congress at London, in 1872, in demonstrating the prompt effects of ether, in showing a simple method of administering it, and his impressive appeal in favour of it. Third, the demonstration of the Chloroform Committee, by experiment upon animals, of the minor degree of danger from ether. And now we are told it has the preference in many of the metropolitan hospitals, although chloroform is by no means abolished, while its use is extending through the country, and at the north especially, the mighty influence of Keith, with his splendid ovariotomy record, is powerfully felt in its favour.

In Germany chloroform has held a less disputed sway than in any other country, and is now, Dr. Kappeler says, so far as he knows, exclusively used. In Austria, however, the course pursued by Billroth is an index of the lack of full satisfaction with either chloroform or ether. He is an advocate of, and constantly uses, a mixture consisting of three parts of chloroform, one part of ether, and one part of absolute alcohol.

In regard to this country it is difficult to make any general and absolute statement of the past or the present, which being true of some sections would not be untrue as to the whole. Dr. Kappeler contents himself with stating that ether has never been entirely laid aside, but has always shared, even outside of Boston, professional favour. He gives as authority the statistics of the civil war: chloroform administrations, sixty per cent.; ether, thirty per cent.; mixtures of the two, ten per cent. Also those of the Marine Hospital [Service?] of the United States for 1874: chloroform, fifty-two per cent.; ether, thirty-five per cent.; mixtures, thirteen per cent. Of course in Boston, and throughout the territory where her influence is felt, which is certainly all of New England, ether has reigned supreme. We do not believe, however, that the statistics given above correctly represent the relative administrations of the two agents through-

out the rest of the country by the profession at large. In our opinion chloroform was almost exclusively used, outside of New England, up to the few past years. Within ten years the current has been setting more and more strongly in favour of ether; the number of deaths from chloroform have become so numerous that they could not be overlooked; many have occurred under circumstances which afforded no plea as an escape; so that its dangers have been forced upon the attention of the profession, until now there is a feeling of distrust and fear which approaches to a general belief in the criminality of its employment except under special circumstances. Probably an exception must be again made in regard to this statement as to the South, that part which formed the Confederacy. There we believe chloroform to be much more generally employed and more freely resorted to than anywhere else in this country. We base our opinion upon the able and enthusiastic championship of this anæsthetic by Dr. Chisholm, of Baltimore, the only printed, as it is the warmest, advocacy of chloroform which has come to our notice for many years;[1] also upon the statement of Dr. Landon B. Edwards, given in Dr. Turnbull's work (pp. 110–111). This confidence in chloroform seems to be based upon the experience of surgeons with it in the Confederate army, and at the North we have found the warmest advocates of this anæsthetic among men who had large surgical experience during the late war.

We will give Dr. Kappeler's general statement of the present position of the subject in England, which will indicate also his opinion of the relative merits of the two anæsthetics and the direction in which he anticipates further knowledge.

"The re-introduction of ether in England had as consequence a very considerable and important improvement in the art of administering it. It is undeniably more skilfully given, its effects more rapidly produced, and it is used with less discomfort and unpleasantness to the patient; yet in spite of all this ether has not the general usefulness and reliability of action, the simplicity of administration, the insignificance of after-effects of chloroform, and only the proof, based upon the broadest foundation of clinical experience, that ether narcosis was *considerably* less dangerous than chloroform narcosis, can give the victory to ether. This proof, however, has as yet been by no means furnished. Since the introduction of ether to England there has been recorded a considerable number of deaths from it, besides those formerly known, and the fatal cases have been where necessary precautions had not been neglected and such that the cause of death must with justice be attributed to the ether. It will be shown, farther on, how difficult it is to decide as to the relative danger of different anæsthetics, to attain to a correct percentage of the mortality from chloroform and from ether, yet it is probable that if in England, the country most favourably situated by the number and concentration of its medical institutions, the advanced standing of its medical societies, and the careful attention which from the beginning has been devoted to this subject, the deaths from ether shall be published with the same conscientiousness with which the deaths from chloroform have heretofore been made known, the materials will soon be obtained for the decision of a question so important for medical science as well as for suffering humanity."

Death under anæsthetics is of course the great and important fact connected with their use. The event is so shocking and painful to all concerned, the reverse is so dark where, without this, all is so brilliant, that its occurrence has from the first excited the deepest interest and stimulated the most scrutinizing investigation and closest study. It is safe to say, that it will continue to do so until we shall have attained the

[1] What anæsthetic shall we use? By Julian J. Chisholm, M.D., Baltimore, 1877.

solid basis of assured knowledge. The deaths from chloroform seem to have much increased in frequency of late years, and now amount to a very considerable number. Dr. Kappeler says that "about 300" have been published, but is certain that many are unknown. He knows of four in his vicinity which were never published, and in this connection again takes occasion to compare the English with German journals, very unfavourably to the latter. Dr. Turnbull gives a table of 160 cases which have occurred from 1869 to 1879, and these, in addition to the table of the former edition of his book, make a total of 370 cases. But if the actual number of deaths cannot be ascertained, much less can we arrive at the relative number as compared with the number of administrations, a piece of information which would be of the greatest interest and most important value. Every effort at computing the total number of inhalations as compared with the number of deaths has been in the highest degree unsatisfactory and but the merest guesswork. Where statistics are reliable there is shown the widest variation in the proportion. Many of the deaths occurred of course to individuals who had administered the agent comparatively but a few times. In one hospital there was one death in 525 administrations, while on the other hand there is Syme with 5000 cases and no death; Nussbaum and Billroth in Germany, the first with 15,000 cases, the second with 12,500, and no deaths; Dr. M'Guire in this country, 15,000 cases and one death; the French army in the Crimea, 20,000 cases and no death; our army in the civil war, one death to 11,448 administrations. The computations of Dr. Andrews and Dr. Coles, of this country, are both given by Dr. Kappeler, the former making one death to 2723 cases, the latter one to 2873. Richardson's estimate is one death to every 2500 administrations, but his figures, made up of over 35,000 cases recorded in English hospitals, show one death to 3196. These may serve as indications and approximations; where two factors of the problem are not and cannot be known, it is useless to look for an accurate third. Whatever may be the mortality from chloroform, either absolute or relative, there are some points which cannot be left unconsidered without injustice. Thus, all cases should be deducted in which the administrations were by an unqualified person, or where the plainest rules of safety were violated. Thus in Dr. Turnbull's table of 160 deaths, in eight the administration was by a dentist or chemist, and two were cases of self-administration, = six per cent. In a collection of 133[1] cases there were seven cases of self-administration. Dr. Kappeler enters the plea that after all the figures, and admitting that chloroform is an element of danger in and of itself, yet it is at least doubtful if the cases of sudden death during operation caused by it exceed those which took place from fright and terror before it was known. He might have said even more than this. In Edinburgh, at an early time in the history of chloroform, when its administrations had amounted to many thousands without accident, there had occurred during the same period two sudden deaths on the operating table of this character.[2]

[1] Am. Jour. Med. Sci., Oct. 1867.

[2] Sir J. Y. Simpson's Works, Anæsthetics, p. 146.

We cannot imagine how Dr. Turnbull should attribute to the writer of this the view that death in the earliest stages is caused *only* by emotion (p. 96), as we have only maintained that to be one of the causes of death. He takes occasion to say that he does not agree with this view, "else the same result would have followed when ether or nitrous oxide is employed." Well—turning to p. 201 of his work, where is recorded the death from nitrous oxide reported by Dr. Newburgh, of New York, we read that "the inference seems entirely justified, that death was not caused by nitrous

But the cause, or rather the physiological process of death under chloroform is a subject of far deeper interest than a computation of numbers. The importance of the inquiry is at once apparent, for the *modus operandi* of the deleterious influence once discovered, the way to avoid the peril would be plain. So, to account for these deaths, we have had explanations without number, hypotheses the most untenable, and theories the most fantastical; ingenuity has been taxed to the utmost in the formation of some of them, and logic torn to tatters. This may seem to be exaggeration, but the facts warrant every word, as a brief examination will show. Thus we have so high an authority as Mr. Lister[1] maintaining that the greater number of deaths from chloroform arose from an "overdose from too long-continued administration;" and this in face of figures showing that nearly fifty per cent. of them took place before narcosis was complete, and a large number during the very earliest stages.

The theory of a peculiar idiosyncrasy on the part of the patient, originating with Robert, has found lately an adherent in Billroth.[2] Yet we find no such idiosyncrasies in regard to other medicines; somewhat greater effects may be produced in some patients than others, but opium, strychnia, or arsenic never cause death when administered in ordinary doses. But admitting the most extreme claims for the existence of idiosyncrasy, in order to accept it as a satisfactory explanation of death from chloroform we must admit that it is as changeable as the wind. A large number of those who have died under chloroform had taken it before, some of them several times; then we must assume that a patient may have to-day a constitution under which a medicine is safe, and to-morrow such an one as renders it fatal.

An explanation of death was found for a time in impure chloroform, but this theory had but a short life, and we then had theories of chemical and of mechanical effects. According to some of the former, oxygenation of the blood was interfered with in various modes, or the vital fluid was directly acted upon and changed, and by the latter it was now a mechanical closure of the larynx, and again an expansion of the anæsthetic in the nervous centres producing death by compression of the delicate structures!

The mechanical theory of death from a collection of mucus in the larynx and air passages was soon shown to be false by performing tracheotomy on animals and by failure to find the alleged cause *post mortem* in a single case. That in regard to obstruction by falling backwards of the tongue is yet in vogue. But the knowledge of the possibility of this accident furnishes a reliable safeguard, and, as Dr. Kappeler well remarks, in all the later deaths there has been no sin of omission upon this point in a single case, yet, nevertheless, the deaths occurred.

Some of the theories have been more plausible, more reasonable, and, because accounting well for a fair proportion of the cases, have enjoyed for a time the favour of many, both leaders and led in the profession. Of these the doctrine that the cause of death lies in faulty administration has been the longest lived, for it began with Sedillot's "le chloroform pur et *bien employé* ne tue jamais;" and is yet in vogue with some. It accounted, and to our mind satisfactorily, for those cases which elude all other explation, where death takes place in the very earliest stages. The sudden and violent impression upon the terminal branches of the par vagum produced,

oxide gas," but it is "entirely probable that the cause of death was *nervous shock* from *dread of pain and apprehension* of fatal effect from the inhalation of an anæsthetic agent"!

[1] Holmes's Surgery, vol. v. p. 488.

[2] Kappeler, p. 110.

by reflex action, sudden cessation of the heart's action. Such a view is supported by analogy, is reasonable, clinical experience accords with it, and it is, Dr. Kappeler says, the teaching of all late physiological experiments. Nothing sustains this view more strongly than the report of the Anæsthetic Committee as to the variation in blood-pressure in rabbits produced by the addition of more chloroform, the animal being partially anæsthetized :—

"When the animal is not fully under chloroform, *any fresh administration causes most remarkable variations in blood-pressure*, with retardation of the heart's contractions."

No one can critically examine the record of chloroform deaths without being struck with the number in which the fatal event followed immediately upon the addition to the sponge or apparatus of a fresh supply of the anæsthetic agent.

The theory of faulty administration as the sole cause of death from chloroform is a peculiarly seductive one, especially to those who have had large experience without meeting with a misfortune. Some special mode of administration, or some measure of precaution, like the preliminary dose of whiskey, is seized upon as an explanation of the immunity from accident, and then the work of convincing others, that "if my plan be followed there is no danger," is entered upon with enthusiasm and positiveness! We have felt in the past all the force of this doctrine, because fully convinced that many deaths have been caused by mal-administration, because this doctrine gave the best ground for the continued use of an agent that we did not wish to abandon.

But the theory is no more tenable than the others. To assume it to be correct we must first conclude that the chloroform was badly administered in all those cases of death in hospitals, where it was in the hands of men who had made it the subject of most careful study, who had had large experience, and who devoted to its use the most scrupulous care. We must conclude that Snow did not know how it should be given, that Simpson himself, after introducing it, and after using it for nearly thirty years, did not know how to administer it. As Dr. Kappeler remarks, a speedy end has been brought to many a dream of fancied security and belief in the harmlessness of chloroform.

Next comes the theory that death is caused by the inhalation of too concentrated chloroform vapour. This theory is sustained by all the points which explain the early deaths as already given, and also in the most marked manner by experiment upon animals, which show, too, that it is not alone in the early stages that death is thus caused. This was the theory of Snow, and his influence was powerful in causing its reception, especially in his own country, where it has always been the favourite theory. It "runs like a scarlet thread," to use the expressive language of Dr. Kappeler, "through all the chloroform literature of England." To this theory the existence of inhalers is largely due. Experimenters had agreed very closely in the results obtained, and had fixed very nearly the due proportions of air and chloroform vapour for safe administration. Thus Snow gave five volumes of vapour to ninety-five of air, and showed plainly that ten per cent. was dangerous. Lallemand, Perrin, and Duroy found that animals lived a long while in a four per cent. mixture of chloroform vapour, but died rapidly in one of eight per cent. The English Chloroform Committee stated the maximum for safety to be four and a half per cent. As it was a simple problem of mechanics to construct a machine

regulating the amount of vapour inhaled, and the due proportion of air, the vital problem seemed equally easy of solution. Yet what has been the result? The history of inhalers for chloroform administration is full of disaster. Of thirty fatal cases, carefully selected as bearing close scrutiny in regard to every precaution having been used, the administration was by an inhaler ten times. Anstie had dangerous symptoms once in one hundred and forty-five times, and used an inhaler in two-thirds of his cases. Of ninety-five fatal cases reported by the Chloroform Committee, an inhaler was used in twenty-eight. The best device, and indeed a perfect instrument, for insuring a due and known mixture of chloroform vapour and air is Clover's rubber bag, into which is introduced a measured quantity of the anæsthetic, and breathing from which by no possibility can the patient get an undue proportion. Yet of fifty-six fatal cases tabulated by Dr. Kappeler five took chloroform from Clover's bag, and in four other of these cases an inhaler was used. Moreover, this source of danger has been recognized by the profession long enough. Sansom, following in the footsteps of Snow, emphasized it. It has neither been overlooked or forgotten, and still deaths from chloroform have rather increased than diminished.

Diversity of opinion as to the mode in which death under chloroform takes place has been equally marked. There have not been quite as many different doctrines and explanations, on account of the limited number of vital organs of the body to which they could be attached. The blood, the nervous centres, the heart, and the lungs, have each severally been looked upon as the special seat of action of the deleterious influence. Asphyxia, syncope, paralysis of the heart, interference with the functions of the nervous centres of circulation and of respiration, destruction of the corpuscles of the blood, and of the nervous cells by chemical action of the inhaled vapour, have all had their advocates, and no one of them has been satisfactory to or accepted by all. It would seem to a layman, perhaps, that there could be no excuse for this diversity of opinion on so momentous a subject, and that order would be speedily brought out of confusion by the results of *post-mortem* examinations. Yet this generally reliable resource fails here. Examination of the bodies of those who have died under chloroform does not furnish any uniform change or condition of any of the vital organs. Fluid blood, the one single universal condition, belongs to sudden death without reference to the cause. The lungs have been sometimes congested and sometimes anæmic; and the brain in various states as to the amount of blood in its vessels. Marked changes are generally found in the heart, but they are not uniform; it is sometimes distended and sometimes contracted, although in the majority of instances the right cavities are loaded with blood. Many of the deaths being distinctly cardiac in character, a determined effort has been made to connect them with a pathological condition of the structure of the heart, fatty degeneration of its muscular fibre, and this condition is looked upon throughout the profession, we believe, as one of peculiar peril for the administration of chloroform. "Fatty degeneration of the heart" is readily accepted as a sufficient explanation of the fatal result. Dr. Kappeler does not share in this view, denies, indeed, that it has any sound clinical foundation, and since the point is an important one we will give his reasons. In his table of one hundred and one cases of death the results of *post-mortem* examination are fully given in fifty-three. In the report of these examinations fatty condition of the heart is mentioned more or less explicitly sixteen

times, yet only five times was it based upon a microscopic examination. He then says:—

"But it must not be forgotten that in these examinations the charge of fatty heart is made in order to relieve chloroform and its administration, and that, therefore, to a minimum amount of degeneration an importance is ascribed which in reality it has not and which would not bear a critical investigation.

"I cannot avoid stating here what my friend, Prof. Roth, of Basle, a careful and conscientious observer, wrote upon this point: 'Minor degrees of fatty degeneration of the heart I meet with in the sections I make, with very great frequency, under the most various circumstances, in advanced age, in acute and chronic diseases, etc., and I do not rely upon ocular but upon microscopic examination.'

"That to fatty heart is to be ascribed only a relative and by no means an absolute danger, is apparent from the fact that of my sixteen patients with this complication eight had already before, and mostly but a short time before, inhaled chloroform, and in view of the great danger that is ascribed to this pathological condition it has always appeared surprising to me that I have never met with an unpleasant symptom in chloroforming for twenty-six amputations on account of senile gangrene, in which, besides the affection of the arteries, in four cases wide-spread fatty degeneration of the cardiac muscle existed as shown by *post-mortem* examination and microscopic investigation. Also, I failed to find in the literature of the subject a single case of death from chloroform when it was given during the existence of senile gangrene, a condition which is notorious for frequency of association with disease of the muscular structure of the heart. I remember Virchow's words: 'Of very great importance is the condition of the cardiac muscle, which especially in senile mortification is *very frequently atrophied and the subject of fatty degeneration.*'"

A careful examination of all the facts will show, we believe, that the heart has received too great a share of attention as the starting point of disaster from chloroform, and that the importance of the respiration in this respect has been overlooked. Of all the vital functions this is the most immediately affected by inhalation of chloroform, and upon this there is a twofold action, the direct influence of the vapour upon the air-passages and an indirect influence through the respiratory nervous centre. Of all the vital actions respiration is the most variable under the administration, passing through all degrees of irregularity and even to complete cessation of considerable duration from tetanic muscular contraction. In animals it is the function which constantly succumbs before the circulation. A critical examination of reported cases of death sustains this view. Thus in Dr. Kappeler's list, and we give this alone because it is the latest contribution to the subject, and time will not permit full presentation of all cases, there are forty cases in which the symptoms preceding death were well described and carefully recorded. In seventeen of these the danger was first announced by the respiration, and this function ceased before the action of the heart stopped. Of these cases two groups may be formed, the first in which narcosis was perfect, ten cases; a second, in which full anæsthesia had not been reached, seven cases; in all the latter death took place during great muscular excitement or rigidity. Where the facts are fully known it appears, therefore, that in over forty per cent. the death was not cardiac, but directly or indirectly respiratory.

Death by a direct action on the nervous centres, of which the cardiac and respiratory symptoms were the expression, was probably too simple a theory to be popular. Explanation of this action by surmising a dissolution of the fat of the nervous molecules, a deleterious influence upon the protagon, and similar hypotheses were plenty. But the commission of the *Société Médicale d'Emulation* reached the plain truth. It denied that the

sudden deaths were caused either by asphyxia or by cardiac paralysis, but rather by a "cessation of the function of the nervous centres, which absorb the anæsthetic vapour, their excito-motor power is destroyed, respiration ceases, then the circulation, and death results."

Accumulated facts and their study brought finally the only conclusion possible. Among all the conflicting opinions as to modes of death and different theories as to its causes, the majority contained more or less of truth, some were absolutely correct, yet no one of them would suffice to cover the whole ground. In other words, the causes of death are various and the modes of death are different. Chassaignac and Maisonneuve recognized a death by syncope and by asphyxia, and they were followed by Weber who amplified upon them. Then came Sansom's excellent work teaching that death may be by syncope, by asphyxia, and by necræmia.[1] Later, in 1870, Richardson gave four classes, death by syncopal apnœa, by epileptiform syncope, by cardiac paralysis, and death by depression of the nervous system. Erichsen also recognized three modes of death: by asphyxia, by coma, and by syncope. To this class of authors Dr. Kappeler belongs, and we may give his views as presenting the result of the latest and a most careful study of the subject. At the outset he makes the statement that "in spite of the large amount of physiological study as to the action of chloroform, which has been successful in substituting much knowledge for hypothesis, and in spite of careful clinical observation, it is not yet possible to give a satisfactory explanation of all deaths from chloroform." It is indubitably proved, he says, that there are a large number of the deaths from syncope, cardiac, and also a large proportion from asphyxia, the respiratory actions ceasing before the circulatory. Referring to his table of the deaths by syncope, seven took place before complete narcotism was produced, some of them at the very outset of the inhalation. A portion of these he says undoubtedly belong to that class of well-known sudden deaths on the operating table before chloroform was discovered. We would suggest, also, that the administration of the anæsthetic itself, introduces a new, a mysterious, and a powerful emotional influence quite as likely to cause death in this manner, as fear of the operation. A great dread of the anæsthetic has been a striking feature in some of these cases, and, as seen in a case already referred to, not confined alone to chloroform. As accounting for other of these deaths, he fully accepts two explanations for which we have always contended: first, a death from shock, the primal impression being the surgical operation, the patient being only partially anæsthetized, producing by reflex action cessation of the heart's movements; and second, one in which the impression is upon the air passages by the sudden inhalation of concentrated chloroform vapour. The syncopal deaths occurring under the full operation of the agent he explains by syncope, a syncope which is the direct effect of the chloroform. It is not that chloroform, by its depressing influence, converts a syncope originating in other causes into a fatal one, but "the syncope itself is produced by the chloroform." The deaths by asphyxia he also divides for study into those occurring while narcosis is incomplete and those when it is perfect. In the former the dangerous symptoms have always been preceded by great muscular excitement and contraction, and whatever expla-

[1] Dr. Kappeler refers to and quotes an article published in the number of this Journal for Oct. 1867, but why he has added a class of "cases affected with chronic heart disease," which is not to be found there, it would be difficult to explain. He does not seem to recognize that Class VI. of that article illustrates and sustains his own conclusion, announced a few pages further on, that some cases are entirely inexplicable.

nation may be made of them the favouring influence of the tetanic contraction of the chest muscles and its retarding influence upon the respiratory process, must not be overlooked. For asphyxia in deep narcotism the direct influence of the agent upon the respiratory nervous centre is to be considered. For these and the cardiac cases, whatever may be proposed or suggested, possible or probable, "we are fully justified in assuming a sooner or later appearing paralysis of the centres of respiration and circulation situated in the medulla oblongata."

A careful, a thorough, an exhaustive study of the action of chloroform, and of the accidents from it, leads inevitably and unmistakably to but one conclusion. With the single exception of the suddenness with which danger appears, there is nothing regular but irregularity, nothing certain but uncertainty. Neither the direction from which disaster may come nor time of its occurrence is to be relied upon. Even when the administration has ceased, the point of safety has not been reached. In Dr. Kappeler's fatal case, two minutes had elapsed since any chloroform had been inhaled, and this is not a single instance. It may be objected that possibly there is a mistake about this and some other points, that the circumstances are not favourable for accurate observation. Then we will refer to the experiments made by the British Medical Association Committee, the accuracy and carefulness of which place the seal of demonstration upon this feature of the action of chloroform. We quote from the report, italicizing some of the words and sentences.

"Chloroform may cause death in dogs by primarily paralyzing either the heart or the respiration. The variations in this respect *seem* to depend to some extent on individual peculiarities of the animals.

"Chloroform has sometimes an *unexpected* and apparently [?] *capricious effect on the heart's action*, the pressure being reduced with great rapidity almost to *nil*, while the pulsations are greatly retarded or even stopped. The occurrence of the *sudden and unlooked-for* effects on the heart's action seems to be a source of serious danger, all the more that in two instances *they occurred more than a minute after chloroform had ceased to be administered and after the recovery of the blood-pressure.*"

It is this irregularity and uncertainty of action which has shaken confidence in chloroform, and the demonstration of this stamps it as a *treacherous* remedy, and shows that no measures of precaution can prevent, no care avert disaster. Velpeau, at an early period of the history of chloroform, discerned this, and made his declaration to the French courts, that it might cause death in spite of all precautions. Richardson, after a careful study of the subject, said, "that no human skill in applying it can divest it of its dangers;" and now comes Dr. Kappeler to repeat, almost word for word, their opinion as the result of his study and experience. It is the conviction of this uncertainty and unreliability which has turned the current of professional opinion away from chloroform; which has caused hundreds to abandon its use, not willingly, but sadly, in obedience to the stern logic of facts. We can appreciate and realize the feelings under which they have acted. Honouring chloroform for the wide extension it has made to the bounds of operative surgery, esteeming it as the chief handmaid of their art, cherishing it for the untold human suffering it has abolished, prizing it for the certainty, the celerity, and the pleasantness of its action, they have yet felt compelled to give it up. They have parted with it not without some of that emotion which, it is said, should not enter into science; they have parted from it as they would bid farewell to an old friend, prolonging the last grasp of the hand, delaying to speak the final

word, sick at heart with the feeling that but for one fault there could be no other such friend as this.

Yet chloroform is not going to pass into oblivion, or even into entire disuse. There are two classes of cases in which, in all human probability, it will still be used, because the benefits resulting from it are immense, and the dangers to be feared from it as nearly as possible at zero. As an anæsthetic for children chloroform stands yet unrivalled; and when a better one is found the profession will truly have cause for congratulation. Deaths have occurred from it, in this class of subjects, it is true, but so rarely that we believe it entirely justifiable to use it, and even repeat it daily for a painful dressing or examination. Dr. Kappeler's table contains two cases of death of children—one two, the other four and a half years of age; Dr. Turnbull collects eighteen cases as having occurred since 1849. No numerical estimate of the proportion can be made, yet clinical experience has fully shown that the amount of danger to this class of subjects is infinitesimal. Even the last-mentioned admits the use of this anæsthetic for "very young children."

Women in labour constitute the other class of cases for which chloroform bids fair to be yet long used. As an assuager of the pains of parturition it has proved itself efficient, reliable, without danger, and with only disadvantages and drawbacks that can be avoided by such careful and judicious use as should always attend the administration of potent remedies. So well recognized are its advantages, not merely as an anæsthetic for surgical obstetrics, but as an agent for the diminution of suffering, that the use of it in natural labour is no longer defended or apologized for in our text-books, but directed and, under proper restrictions, encouraged. Of all the gifts of medicine for the alleviation of the suffering of woman, this is the brightest and the best.

Entertaining these views, we can feel but little satisfaction with Dr. Turnbull's treatment of this part of the subject. He grudgingly admits that the experience of British practitioners "is generally understood to have disposed them to regard the use of chloroform in labour as a proceeding of the highest utility and moment and practically free from danger." This is all he can say in its favour. He alludes to France, where chloroform in labour has "not yet become acclimated." It is true that some honoured names in the roll of French obstetrics have opposed its use for the relief of pain.[1] Yet the extent of their experience may be judged of from the fact that they have taken the utterly untenable ground that there is no such thing as demi-anæsthesia, even ridiculed its existence. On the other hand, there have been able advocates for its use even in France, and the dissenters have been but a fraction of the profession.

Dr. Turnbull copies the conclusions of a paper read by M. Richard before the International Medical Congress of Geneva, the first of which reads: "The employment of anæsthetics is, as a general rule, advisable in natural labour," with the remark that "they are *not generally approved of* by the majority of gynæcologists." [?] He should have named

[1] It would be interesting to know how much *personal* feeling has had to do in this matter. It would not be the first time that such feelings had influenced the progress of science. The late Charles James Campbell, of English birth, won for himself in the French capital a brilliant reputation, a most enviable position, "with immense practice, and crowds of wealthy and influential patients from all countries." He was an ardent advocate of chloroform in natural labour, and his success was largely due to his use of it. This, naturally enough, would not be very pleasant to native Parisian obstetricians, and conservatism and personal feeling might be easily confounded. See Dr. Playfair's Annual Address to the Obstetrical Society of London.

the dissenters and given their opinions. He quotes from Dr. Lusk the conclusions of a paper read by that gentleman before the American Gynæcological Society on "The necessity of caution in the use of chloroform during labour," and fails to copy the statements made in the body of the paper that the administration of chloroform during natural labour is legitimate, or the admission that there is not on record a well-authenticated case of death from it during labour when administered by a qualified medical man. Having read this, as he must have done, he gives as an instance of death from chloroform during labour, without any comment, a case in which the patient had had a convulsion, for which the anæsthetic was administered, and just before she died she had another "slight tremor." [Convulsion?] He gives again, without comment, a case in which "*three pints of chloroform*" were used as an instance of its injurious effects! All this is not fair, and it is upon this that we base a charge of lack of the scientific spirit as a feature of Dr. Turnbull's book.

It is not an easy task to arrive at satisfactory conclusions in regard to ether, or to state fairly its relative results. We are not here embarrassed by the number and variety of theories as to its action, for the difficulty is rather a paucity than an excess of literature. It is a singular fact, in view of the rapid advance in favour of this agent, its importance, and the extent to which it has displaced chloroform, that it has not been the subject, now for many years, of a complete and thorough treatise. Partisanship has come in, perhaps to warp testimony, certainly to influence judgment, and we find disagreement as to facts and varying deductions from those who have presented us with the result of their studies, and to whom we look for our information.

Restricting observation to the more prominent symptoms and the major functions affected during administration, it may be said that in only one point do ether and chloroform present a close similarity of action. This is in regard to the depression of temperature produced by them. It is the result of Dr. Kappeler's careful study, that a fall takes place without exception under both; this with ether varies from .3° to 1.5° C., average .68, and with chloroform from .2° to 1.1°, average .59. Leaving out the cases having fever, and the remarkable correspondence is shown of .53° for chloroform, and .52° for ether.

Irregularity of respiration is common to both, but is much more marked with ether than with chloroform. It begins with ether at an early stage with that sense of suffocation which its vapour produces, and which is one of the most unpleasant and most unbearable of sensations, it is marked during the whole course of administration until the regular snoring of deep insensibility comes on. This marked interference with this important function is closely allied to or consequent on the much greater amount of muscular excitement produced by ether. While violent muscular action is exceptional with chloroform, it is almost constant under ether. In two hundred administrations Dr. Kappeler saw it violent and long-continued in two-thirds of the cases, and in only ten, all but two of whom were children, was it absent or but slight. That this general muscular rigidity with tetanic contraction of the chest-muscles is a period of special danger with chloroform has already been shown, that the danger at this point is not so great under ether we believe certain. Dr. Kappeler saw only three cases in which it became necessary to resort to measures of relief. He admits, in regard to this feature, that much depends upon the manner of adminis-

tration. Since he has used Clover's lesser apparatus he has found the stage of excitement much less marked.

It is in regard to their effects upon the circulatory system, upon the action of the heart and the blood-pressure in the arteries, that these two agents differ most widely, and the consideration of this difference assumes the highest importance from its close connection with death under their influence. The generally accepted view we believe to be that ether exerts a decided stimulating influence upon the heart and circulation. That it does not exert a depressing influence seems to be the unmistakable result of experiment upon animals. This was plainly shown by the English Chloroform Committee, and it is again shown by the Anæsthetic Committee now pursuing its investigations. We would rely upon any decision reached by that committee with absolute confidence for reasons already given, and the result of this latest and scientific study is that while both chloroform and ethidene administered to animals have a decided effect in reducing the blood pressure, "*ether has no appreciable effect of this kind.*" "*It may be given for an indefinite period without interfering with the action of the heart.*"

But when we turn to investigations as to this point made upon human beings we regret to find that the testimony does not agree. Dr. Turnbull quotes the observations of the late Dr. Morgan of Dublin with the sphygmograph, gives the tracings, and quotes from him that "the most perfect anæsthesia could be invoked under the influence of ether, with an absolute stimulating effect on the circulation." Dr. Kappeler says that "in ether narcosis deep enough for painless operations, an alteration in the pulse-curve does not follow in every case, while in deep chloroform narcosis the pulse curve shows, without exception, characteristic and marked changes." He has made ten careful observations, and gives in his book seven of the tracings:—

"Of these ten there were three in which no change, or a scarcely perceptible change in the curve, took place, although the patients were deeply anæsthetized, an occurrence not found in one of the twenty-five cases of chloroform narcosis; *in seven of the ten cases the curve of deep ether narcosis differed not at all from that of chloroform narcosis.*"

This brings us to the consideration of the mode by which death under ether takes place. The general impression we believe to be that death never occurs under this anæsthetic with the frightful suddenness that it does under chloroform, that it is always respiratory and not cardiac. The question is of course no trifling one, since if the route of disaster is by the respiratory function the danger is announced, and there is an immense amount of resource for rescue, while if it is by the heart there is no warning, and the patient is generally dead before the first efforts at resuscitation can be put in force. Dr. Turnbull is positive upon this point. He says that ether "always gives warning before it causes the death of the patient." Nevertheless, cases 6 and 8 of his own table, given only a few pages from the above statement, seem to have been as sudden as any under chloroform as far as can be judged from the brief reports. Dr. Kappeler finds four cases out of nine deaths under ether, in which the fatal symptoms arose from the circulatory apparatus as well as from the respiratory, and in which the death was sudden.

It is at once a singular fact, and a matter for regret, that neither of the works under consideration makes any attempt to present the total number of deaths which have occurred under ether. This seems to be a very im-

portant matter, when chloroform is under consideration, but of no consequence in regard to the other anæsthetic! Dr. Turnbull's table contains eighteen deaths, of which nine present no extenuating circumstances, and are pure ether deaths, yet the time covered is only from 1873 to 1878. Dr. Kappeler gives thirteen fatal cases, nine immediate and four soon after administration. Of the nine immediate, two cases were certainly and one probably suffocated by ingesta getting into the air-passages, and three underwent severe operations, leaving four deaths due to the anæsthetic. His collection contains no case previous to 1872. There is a long gap between Perrin and Lallemand[1] and these authors which we do not know how to fill, so that our knowledge upon this point is singularly lacking.

It will have been noted that Kappeler gives a class of deaths occurring after the administration is over, and in this respect ether is no more free from reproach than chloroform, indeed is more open to it. He refers to the investigations of Lallemand, Perrin, and Duroy, as showing that "ether is retained a longer time in the organism, and has therefore a decidedly more prolonged operation." The fact is beyond question and an instance was lately testified to us by an eye-witness. The patient was a healthy young man, the operation extirpation of the eyeball. It was performed under ether, had been completed and so far over that all were engaged in examining the specimen, when all at once dangerous symptoms were manifested by the patient, and only most energetic measures succeeded in saving him. This case has never been published, and it may be mentioned as one offset to the point made, and justly made, in regard to the mortality from chloroform, that very many cases have never been made known.

In attempting to estimate the ratio of deaths from chloroform to administrations one factor is, approximatively, known—the number of deaths. But even this is lacking in regard to ether, and figures are no better than guesswork. We miss very much, as to ether, such statistics as those of the armies of different nations, and those prepared by Dr. Richardson from the hospitals of England in regard to chloroform. Nevertheless, the current doctrines of surgery and the practice of the art do not always depend upon numerical statements, and for the relative safety of the two great anæsthetics we must get what we can from figures and then go beyond them. The authors of the *Traité d'Anæsthesie Chirurgicale* attempted a comparison of the two by numbers, and arrived at three deaths from ether during the first fifteen years of its use, and seventy-seven from chloroform during the first fourteen years. But as chloroform for a time almost entirely banished ether for use, no calculation can be thus made. We would prefer to take the first year during which ether was used, which gives one death, and the first year of chloroform, when, we may assume, it was almost exclusively used, and that gave nine deaths. The very attempt, without the number of administrations of each, shows how vain it is. In the absence of figures, such general statements as the one made by Dr. Turnbull are important:—

> "In the city of Philadelphia alone it [ether] has been used, with but one exception, since its introduction in 1846 up to the year 1878 . . . without a single primary death and only one recorded secondary death."

The exact meaning of "with but one exception" is not clear. It is not possible that chloroform has been but once administered in that city within that time, or that it has been used by but one surgeon!

[1] Traité d'Anæsthesie Chirurgicale, 1863. They give three deaths from 1847 to 1859, yet Dr. Turnbull, p. 32, gives only four deaths as the number up to 1872.

All the general testimony of this kind is decidedly in favour of the far, the very far, greater safety of ether as an anæsthetic as compared with chloroform. The tone of medical journals as they record the frequent deaths from the latter, the current of professional opinion, the abandonment of the one agent for the other by surgeons almost everywhere, show that the lesson has been learned from facts quite as well as from figures.

Dr. Kappeler, in summing up, says:—

"It is not possible to obtain an insight into the mechanism of death under ether from such a scanty number of observations. Only further experience and numerous new observations can throw light on the subject. And it is by no means apparent from the material before us that ether-death in human beings is essentially different from chloroform-death, or that, as physiologists hold in regard to animals, the fatal result in man always begins by disturbance of respiration, and in every case proceeds from the respiratory system. The assumption of the physiologists (Schiff), therefore, that the surgeon is responsible for death from ether, in contradistinction to chloroform, and that death from ether may always be avoided by precaution, stands, in my opinion, without any foundation whatever. From the experience of the operating table it cannot yet be maintained with absolute positiveness that the administration of ether as an anæsthetic has a considerable less amount of danger than chloroform. We are as little prepared to state in figures the dangers of ether as those of chloroform, since neither the number of deaths from it nor the number of administrations is known, and the few attempts made to state the proportion of deaths to administrations are mostly the product of the bitter contest: ether *versus* chloroform, and the necessary impartiality is lacking. It is well, however, to bear in mind that the late proclamation from Lyons of the absolute safety of ether, and the late disavowal of the same from the same place, brings us *ad absurdum;* that, as already stated, since the resumption of the use of ether in England, deaths have occurred from it in more considerable number, even by careful administration, and that, with the more frequent use of the agent, the number of accidents has increased."

We can by no means assent to the major proposition; cannot understand, indeed, how the author could formulate it from the facts contained in his own book and from the literature of the subject which he has examined. That he does so, indicates, we think, an absence of that impartiality which he so much deplores. If deaths from ether are multiplying so rapidly, he surely should be able to present a greater number than he has, especially from that country where, we are told, it is being more frequently used, and where the enterprise of the medical journals has won his commendation. The truth is, there is no approach in number of deaths from ether to those from chloroform. The proof *is* "based on the broadest foundation of clinical experience" that ether narcosis is not only "considerably," but *very much* less, dangerous than chloroform narcosis. Then we have the testimony of experiment on animals, repeated again and again, and always strong on the side of the relative safety of ether as compared with its rival. When clinical experience and experiment coincide and sustain each other, the question must be considered settled, for there is no higher court of appeal.

But, as with chloroform, other considerations than those of safety alone will influence the use of ether. The difficulties of its administration are not such as to stand much in the surgeon's way. Yet its tardiness of action, especially mentioned by the Anæsthetic Committee, and its unreliability deserve consideration. Turnbull and Kappeler both give cases which could not be brought under its influence. And, again, there is its inflammability, which rules it out of operations by artificial light. Then there is the vomiting, in regard to which, however, we have the widest differ-

ences as to facts. Dr. Turnbull states that in his practice it occurred only once in fifty cases. Dr. Kappeler observed it in twenty-five per cent. of his administrations, against fourteen per cent. for chloroform. Impurity of the article used cannot be adduced to explain this, since he has used only ether from the best pharmacies of Lyons. The disagreeable smell and taste of the ether, which persists for hours, sometimes for days, is a great annoyance to patients; and, although the profuse salivation of inhalation may be a trifling matter, the sense of suffocation which attends it is far from being so. To those who would overlook or despise this feature, we suggest a reference to a jury of those taking it, rather than those administering it. It is at least serious enough to have lately been the subject of an editorial in a prominent medical journal,[1] and we believe with the author of that article that its administration without due consideration of this effect is a piece of positive cruelty.

Mixtures, in varying proportions, of chloroform and ether made their appearance at an early period in the history of anæsthesia. They were the natural outgrowth of dissatisfaction with the disadvantages of ether and experience of the dangers of chloroform. Their use received a powerful impulse from the influence of the Chloroform Committee. The report of that Committee impressed the importance of gradual administration and free dilution of chloroform vapour, both of which are insured by mixture of the liquids, and proved by experiments on animals the less depressing influence upon the heart of the combined vapours. That Committee investigated three mixtures: alcohol one part, chloroform two parts, ether three parts; chloroform one part, ether four parts; chloroform one part, ether two parts; and recommended them for further trial, as combining the effects of the two, and the first especially "on account of the uniform blending of the ether and chloroform when combined with alcohol, and probably to the more equable escape of the constituents in vapour." This mixture, generally known as the A. C. E. mixture, should be called "Harley's mixture," as he first proposed and used it.[2] But, notwithstanding the powerful endorsement and recommendation of that Committee, at a time, too, when the profession was saddened and disappointed by the discovery that chloroform was not trustworthy, none of these mixtures ever succeeded in gaining general confidence or passing into general use. In some localities, and by individual surgeons, these, or similar combinations, have been preferred, and have been used sufficiently to furnish quite a large experience. In this country the late Dr. Atlee used the third mixture of the Chloroform Committee, and under its influence performed three hundred ovariotomies, without accident (Turnbull). The mixture of six parts of ether to two of chloroform has been used so generally in Vienna as to be called the "Vienna mixture," and there have been over eight thousand administrations of it without a fatal case (Kappeler). Billroth, in recent times, has used exclusively a mixture, chloroform three parts, ether and alcohol, of each, one part, believing it to be safer than chloroform.

The accidents from these mixtures have not been numerous. Dr. Kappeler gives two, and Dr. Turnbull four, as occurring in "recent times." Undoubtedly there have been others which have never been recorded, but of the above none occurred with the A. C. E. mixture, nor have we been able to find a report of one.

It may be interesting to inquire why these mixtures have not been received with more favour by the profession, since their record is good,

[1] Medical Record. [2] Sansom on Chloroform, p. 138.

and in view of the high recommendation of the Chloroform Committee and of all the theoretical considerations in their favour. We find the explanation in two facts. First, the occurrence of a death at an early day, which is known as the "Crockett case."[1] Now, looking critically at the facts of that case, we boldly say that there is not a more flagrant instance of transfer of the effect of an operation to the anæsthetic than in this instance, and this is saying a good deal! The boy was five years old, a tumour was removed from his back which required for its removal two incisions "each nine inches long," the operation was stopped to ligate "a large artery," five other arteries were tied, the little fellow lost "four ounces of blood, certainly not exceeding six," and then vomited and died! The rapid loss of this amount of blood, the shock of such an operation in so young a patient, pass for insignificant, and the anæsthetic mixture has been paraded as the sole cause of death, and is so given in the latest work on anæsthesia! This is not justice, nor is it science. But that this case has exerted an immense influence in preventing and restraining the use of mixed anæsthetics we most firmly believe.

The second explanation we adduce is the energy and persistency with which the fact of the unequal rate of evaporation of the various liquids which make these mixtures, has been pushed as an argument against their use. The plea has been that because the more volatile and safer liquids pass off first, the patient will, after a time, get the more powerful and dangerous one alone, when he is supposed to be getting the mixture. It would seem that such an objection is too trifling to have any weight, because it needs but to be stated to be recognized and avoided. The danger is not easily escaped perhaps, if the mixture be given by pouring it on a towel or napkin, the worst way ever devised for the administration of an anæsthetic, because certain to insure uncertainty as to the amount the patient may get at each inspiration, and as to the rate of his progress to unconsciousness; but if given from a sponge, a squeeze now and then, and a fresh addition of liquid, obviates the difficulty at once, and an objection is removed that has been urged, and repeated, and impressed as if it were of equal magnitude with the sudden and irregular action of chloroform.

More recently the strong feeling in the profession against chloroform, has led some who had used these mixtures, to abandon them. An eminent surgeon of the northwest lately stated to the writer that he had long and extensively used the A. C. E. mixture, and had never found cause for dissatisfaction, but that he had given it up solely under the influence of the feeling above alluded to. Our personal experience with this mixture has been such as to enable us to feel the full force of the point made by those who have used chloroform all their lives without accident. By dilution of the chloroform vapour there is no probability of producing death by cardiac paralysis, so prominent a feature of chloroform, while it is prompter in action, more reliable, and less unpleasant, than ether. That it is safer than ether, no one would maintain; that it is less safe remains yet to be shown. Undoubtedly the greater or less frequency of occurrence of dangerous symptoms, could they be ascertained, would be quite as good a test of the safety of an anæsthetic as the number of deaths. In this respect the mixture has been more favourable in our hands than ether in the hands of Dr. Kappeler: he was obliged to resort to measures of resuscitation three times in two hundred administrations. With the A. C. E. mixture

[1] Am. Journ. Med. Sci., July, 1857.

we have been obliged to resort to them but once during some thirteen or fourteen years' constant use.

The modification of the ordinary course of anæsthesia by the preliminary injection of morphia deserves attention. Resorted to first in man by Nussbaum, and its advantages shown about the same time by Bernard by experiments on animals, it has been the subject of numerous articles from time to time since, and has probably been used more in practice than would appear from the literature of the subject. It is claimed for this "mixed narcosis," that it is especially adapted to prolonged operations by rendering a far less quantity of chloroform necessary, the anæsthesia being continued with far less frequent repetition of inhalation, that the stage of excitement, both muscular and mental, is lessened, and that thereby the dangers of anæsthesia are diminished. Mollow, one of its enthusiastic advocates, goes further, and claims that the action of the morphia lessens irritability of the air passages and so restrains reflex action upon the heart, that in this respect its effect is similar to division of the *par vagum;* also that the morphia in small doses, increases the blood-pressure by its action on the motor ganglia of the heart, and by its contraction of the peripheral vessels, thereby opposing the chief deleterious influence of chloroform from the beginning, by presenting an opposition which must be overcome before the vascular pressure can sink below the normal. As to the smaller quantity of chloroform necessary for a given length of anæsthesia, the less amount of muscular excitement and the modified mental condition, Dr. Kappeler says "the advantages have been on various sides clinically proved, and are only seldom called in question."

There have been dissenting voices heard, however; among them, Demarquay, who claimed that the dangers of anæsthesia were by this method in no degree lessened—rather increased by the combination of two such depressing agents. If Mollow's claim as to the action of morphia be correct, of course this falls to the ground. The latest investigators of this method are Heiter and König, who have resorted to it with good results and warmly recommended it. As to danger König sees no difference between chloroform and morphia-chloroform narcosis.

Dr. Kappeler makes a very important contribution to this subject, and gives eleven carefully observed and recorded cases of the simple administration of chloroform and then of the mixed narcosis to the same patient, and almost all of the administrations for the same disease. We cannot omit presenting his conclusions in his own words upon so important a branch of the subject, conclusions drawn, too, from the use of so rare clinical opportunities. He makes the hypodermic injection from twenty to thirty minutes before administering the anæsthetic, and the time is not unimportant, as the stage of excitement is more probably increased than diminished if the one immediately precede the other. He states the amount of muriate of morphia used to have been for adults .015, for children .01.

"From this table, and a larger number of other chloroform-morphia narcoses, (about 150) it appears that the course of the anæsthetic with morphia is nearly the same as without it, that nevertheless the mixed narcosis is in general of a more peaceful character, that the stage of excitement is shortened, and the patient carried more rapidly and with less muscular action into the stage of tolerance. This difference is particularly marked in subjects more or less under the influence of alcohol. Passing to the individual symptoms it may be said that the reduction of the frequency of the pulse occurs in the mixed narcosis about the same as in the simple. Two cases of the table seem to show that the depressing influence of

chloroform upon the action of the heart manifests itself less when morphia is combined with it; yet I saw lately, in the mixed narcosis, the patient a woman thirty-six years old, very dangerous symptoms on the part of the circulation, weak, irregular, intermittent pulse, with pallor of the face, so that the administration had to be stopped; and in my table of deaths from chloroform, there is a case of fatal syncope in which an injection of morphia preceded the inhalation. The temperature falls with and without morphia. The very frequent irregularity of respiration, amounting often to threatened suffocation, appears decidedly less frequently in the mixed narcosis. The dilatation of the pupils of the early stage of anæsthesia is frequently wanting when morphia is given. Muscular contraction is not present in the same degree as without morphia, and sensibility is abolished sooner and more completely, while vomiting is rather more frequent from the combined method. It is entirely certain that after a hypodermic injection of morphia, a greater effect is produced by the same amount of chloroform than without it; that is, a more rapid and a deeper narcosis is produced. The average smaller consumption of chloroform by mixed narcosis reduces somewhat perhaps the danger of the anæsthesia."

It appears reasonable that this process is especially adapted to one particular class of patients, nervous females or any patient looking forward with great dread either to the operation or the anæsthetic. Such powerful and depressing mental influence is the only explanation of the sudden deaths on the operating table before anæsthetics were known; it has been present in not a few of the deaths under anæsthetics. Such mental action is blunted and subdued by the narcotic, and the patient can then be gently conducted along a path which, without it, he could only travel with resistance and fear, if not horror.

It appears that none of the advantages of chloroform-morphia narcosis attach to ether-morphia narcosis. Dr. Kappeler gives his experience with twenty-five cases, the particulars of which it is not necessary to give, and this seems to show that in all respects the combination of these two agents is rather injurious than beneficial. Nor does an experience of seventy cases of ether-chloral narcosis allow him to speak any better of that combination.

Passing to the consideration of anæsthetics other than, and substitutes for, the two great ones, little time need be devoted to nitrous oxide. Its difficulty of preparation, and impossibility of transportation, unless with costly apparatus, prevent its use anywhere except in hospitals, and it is not adapted for general surgical practice. Long and severe operations, such as ovariotomy, have been performed under its influence, but not in sufficient number to establish its relative greater safety. The promptness of its action, the rapidity with which consciousness returns, and the absence of unpleasant symptoms afterwards admirably adapt it for brief operations, as extraction of teeth, while abundant clinical experience has shown it to be for such purposes safe, as safe probably as any anæsthetic will ever be found to be. Dr. Turnbull gives the statistics of the Colton Dental Association up to 1870 as 75,000 administrations, and those of the Drs. Thomas, of Philadelphia, up to 1879, as 58,400, making a total of 133,400, without a single death, and with not more than three in a thousand exhibiting unpleasant symptoms afterwards. Meanwhile it has its black list. Dr. Turnbull gives four cases, in one of which, however, the post-mortem examination revealed a cork, which had been placed between the teeth, in the larynx. Dr. Kappeler gives three fatal cases, one of which is certainly and the other probably in Dr. Turnbull's list. The third deserves record for some extraordinary features. It occurred to Nussbaum. The patient was a hard drinker upon whom perineal section had been performed. For

the passage of a bougie he had taken chloroform *fifty-three times!* the fifty-fourth time he took nitrous oxide and never woke up! Deep cyanosis came on during the administration, and he died notwithstanding respiration continued for fifty minutes, and was maintained fifteen minutes longer by faradization of the phrenic nerves.

Especially adapted as is nitrous oxide for dental operations, and safe as it has been shown to be, the administration of any other anæsthetic by a dentist should be considered criminal.

The bichloride of methylene is scarcely in the field as a surgical anæsthetic. As it has never been manufactured and placed within reach of the profession in this country, there has been almost no experience with it here. Indeed it is difficult to obtain it anywhere pure, different specimens showing varying proportions of other ethers. The Anæsthetic Committee speak of it as "bichloride of methylene, so called, but as it has not a definite and constant boiling point, it is obviously a mixture."

This is well known to be the favourite anæsthetic of Spencer Wells, and his experience, extending to over 350 major operations, 280 of them being ovariotomies,[1] seems to justify him in speaking with great confidence of its merits. This shows conclusively that methylene can be successfully used for the severest operations, yet it proves comparatively nothing as to relative safety, for twice four hundred administrations is but a small number to test an anæsthetic. When it is added that other observers have not found this anæsthetic safe, and that the list of accidents from it is a large one, its use is not likely to be extended. Dr. Kappeler gives the details of nine deaths from it; two of them took place in the Moorfields Ophthalmic Hospital within two years. He details the experience of German surgeons with it, Nussbaum, Hegar, and Kaltenbach and Kocher, none of whom prefer it to other anæsthetics; and his conclusion is that "experience shows it to be as dangerous, if not more dangerous, than chloroform." This, too, is plainly shown by the experiments of the Anæsthetic Committee:

> "With frogs, it was found that the heart became quickly affected and soon stopped. With rabbits, respiration rapidly deteriorated and stopped while the heart was still beating. . . . As in the case of chloroform, the right ventricle became enormously distended—the first sign of paralysis being the commencement of this distension."

If nitrous oxide and bichloride of methylene claim and deserve but little consideration as surgical anæsthetics, two other anæsthetics have recently made their appearance as candidates for professional favour, one of them in England and the other in this country, which are now exciting the deepest interest and attracting the closest attention. The English article is the result of the study of the Anæsthetic Committee for some agent which would be free from the dangers of chloroform. They believe they have found it in the dichloride of ethidene ($C_2H_4Cl_2$, "an isomeride of ethene dichloride produced from aldehyde"). This they have found to yield the best results of all the articles experimented with. The mode and character of the experiments have already been spoken of, and here the results alone concern us. In rabbits anæsthesia was produced in four minutes, and cardiac action continued vigorously for forty minutes. Dogs were anæsthetized in from two to three minutes, and continued half an hour without failure of the heart's action. A most striking contrast was shown by changing the vapour of ethidene to that of chloroform. Under the latter

[1] Diseases of the Ovaries.

"the right side of the heart began almost immediately to become distended and to be dark in colour, and the activity of the heart rapidly failed."

Ethidene is not free from the charge of reducing the blood-pressure, but it does not do it to the same extent as chloroform, and the reduction is "by regular gradations, and not, so far as observed, by sudden and unexpected depressions."

"Under the use of ethidene there was on no single occasion an absolute cessation either of the heart's action or of respiration, although they were sometimes much reduced."

Vomiting is sometimes produced by it, but whether more frequently than by other anæsthetics has not been determined.

The conclusion of the Committee is that although ethidene is not free from danger, it is in a very high degree safer than chloroform; that it is less exciting, more agreeable than, and as rapid in action as chloroform; and that "a very strong case has been made out for an extensive trial of it."

The experiments upon animals with ethidene seem to be very satisfactory, and the recommendation of this Committee is a strong passport to professional favour. The amount of clinical experience with it has not been large, but to begin at the beginning of this part of the subject we must go back quite a time in the history of anæsthesia. Ethidene was used by Snow as early as 1851, and his work on anæsthetics contains a chapter on it, under the title of the monochlorurretted chloride of ethyle, in which his clinical experience with it is detailed. He administered it for about seventeen operations, some of them of considerable severity, and from what he saw of its action formed a very favourable opinion of its merits. He says of it that "it resembles chloroform very much in taste and smell, and its physiological properties. Its boiling point is 149°; whilst that of chloroform is 140°; the specific gravity of its vapour is also lower; for these reasons it is considerably less volatile than chloroform, and it is therefore pretty certain that it would not be liable to cause the sudden deaths which have occasionally been produced by the administration of chloroform, even if it were given freely, and with no great care."

Difficulty of obtaining ethidene pure prevented Snow from using it to any further extent, and his last illness fell upon him even as he was writing the last paragraph of his chapter upon this article.

The second report of the Anæsthetic Committee is occupied with the detail of six cases in which ethidene was administered in various operations, most of them not severe, but in one, for the radical cure of hernia, the action of the anæsthetic was maintained for twenty-five minutes. In all its action was satisfactory, and the Committee does not hesitate to say that "it presents all the advantages of ether without any of its disadvantages."

Some other clinical experience with this article has been published in the British journals, all of it favourable to the new agent. Yet there is an opposite side to the account, although it has been so recently opened. First, theoretically, Richardson devoted a great deal of study to the different anæsthetics seeking a substitute for chloroform, and one of his statements of results is to the effect that "all the members of the group of narcotic vapours of the chlorine series are dangerous narcotics." This, then, must be disposed of by further study and observation. Second, and practically, Dr. Kappeler closes the page devoted to ethidene, and in which he speaks most favourably of it, with the following paragraph:—

"Unfortunately, the occurrence of a death from this article, in Berlin, destroys early the hopes which had been cherished of it, and will not permit of a more extended trial."

It is deeply to be regretted that no particulars of this case are given, and in the absence of them it is well to suspend judgment. The list of accidents from anæsthetics is full of cases in which the death is most unjustly charged to their influence and in which the vapour played but an insignificant part.

The other new anæsthetic, and the one which is just now receiving so much attention in this country, is of course hydrobromic ether, or the bromide of ethyl (C_2H_5Br). For its introduction into practice here as an anæsthetic, and for the impulse which has been given to its use and the study of it, we are indebted to Dr. Turnbull. The statement in his book that he "was the first to experiment with this ether upon man," we choose to consider as one of those slips of the pen which are constantly occurring to busy men when they write. Mr. Nunnely, of Leeds, England, used bromide of ethyl on animals as early as 1849, and his experience with it as an anæsthetic with patients was the subject of a paper read by him before the British Medical Association in 1865. Dr. Turnbull has been first to use it here, and to urge its good qualities and its adaptation to use for surgical purposes; and for his enterprise he deserves great credit, as he will receive due honour, should the article prove to be all that its friends claim and all that every one must hope it will prove to be,—as efficient, as reliable, as pleasant as chloroform—as safe as ether. Dr. Turnbull has been fortunate in finding a follower and able coadjutor in Dr. Levis, of Philadelphia, whose position has enabled him to give the article a more frequent use and a wider range of operations for trial. The experience of the former is given in his book, and amounts to seventy-one administrations, of which some particulars are detailed. Dr. Levis states his experience in a more general way, but no testimony could be stronger in its favour. He has "used it under the most varied circumstances which could be required to test the merits of an anæsthetic, . . . and in the most abnormal conditions of debility and shock of injury, in capital operations, through protracted periods of administration, in patients from early infancy to extreme old age," and has been so satisfied with its effects that he is impressed with the "conviction that it is practically the best anæsthetic known to the profession."[1]

The two leading peculiarities of bromide of ethyl are quickness of action and speedy recovery from the anæsthetic condition. The shortest time stated by Dr. Turnbull, in which anæsthesia was produced, was thirty seconds. Personal experience showed consciousness lost with three full, slow inspirations, and complete anæsthesia produced in a minute and a half, while consciousness returned in the same length of time.[2] Pleasantness of effect must also be given as a decided point in its favour; it is pleasanter to inhale than chloroform. As to the frequency with which vomiting attends its use, of Dr. Turnbull's twenty-one cases, in three this symptom followed, which is about fourteen per cent. Dr. Levis states that it occurs less frequently than after ether and chloroform. The state of excitement or struggling is stated by one of these gentlemen to be "short," by the other, "more moderate, brief, and transient than in the early stage of the anæsthesia of ether and chloroform." But upon this

[1] Ethylization: Reprint from Medical Record.
[2] Cincinnati Lancet and Clinic, April 10, 1880.

point the mode of administration has a powerful influence; mixed with air, as is the case with ordinary ether, the stage of excitement is violent and prolonged;[1] given pure and rapidly the above statements are probably correct.

The behaviour of the great functions of circulation and respiration is, of course, the great point in the study of a new anæsthetic, and in regard to these, under hydrobromic ether, we are sadly lacking in accurate information. Dr. Levis has not given any detailed account of administrations. He states, in general terms, "that the circulation generally shows evidences of moderate excitement, as indicated by some increase in the rapidity of action of the heart, and the pulse evinces greater general arterial tension." "The respiration is slightly increased in frequency until anæsthesia becomes complete, when it assumes the character of normal sleep." Of the fifteen cases given by Dr. Turnbull, with more or less detail, in nine no mention is made of these important functions, in one other the pulse is not given; while respiration is stated as not interfered with; in another, the pulse was "slightly accelerated," and the respiration is not mentioned! This leaves only four cases in which particulars of so great importance are given in a study of such a character as this! In one of these the pulse "was not influenced in the least," and the respiration was "slightly accelerated." In case 11 the pulse was, before the administration, 100, after first five inspirations 160, after operation 120. In case 13 the pulse was, before, 100, during the first eight minutes it was 160; the respiration 28, at sixth minute 30. In case 15 the pulse "advanced to 84," the respiration was "not interrupted." Cases 11 and 13 are notable for the enormous increase of the pulse rate, and they correspond with our personal experience, in every instance the pulse mounting in the first minute from about 80 to 120 and rapidly falling. It is singular that so marked a feature, occurring with certainty twice out of fifteen times, should not have occurred to Dr. Levis. How much we miss here the careful observation and minute record of individual symptoms of Dr. Kappeler!

This brings us to the consideration of an unfortunate case reported by Dr. Sims,[2] the only fatal case which has occurred after the administration of bromide of ethyl, a case which has been so prominently presented to the profession, and which has attracted so much attention, that no restatement of its particulars can be necessary. Only those need be looked at which bear upon the question of the safety or danger of hydrobromic ether. First, is the marked effect upon the respiration; it was very rapid, the patient breathed "sixty times a minute." In the debate in the New York Academy of Medicine, which followed the report of the case, another was mentioned (Dr. Little's second), in which "both the pulse and the respiration became exceedingly rapid." It is evident that Dr. Sims's patient did not die from any cardiac influence of the anæsthetic, and this is a point strong in its favour. The operation lasted an hour and a half, during all which time "her condition was good and her pulse was strong and full." We think it must be conceded that she did not die from shock or from any direct influence of the operation as the major factor; the time at which death took place, twenty-one hours after the operation, would militate against this, but more especially the marked symptoms present, of

[1] See Dr. Sims's first, and Dr. Little's second case, Med. Record, April 3, and Cincinnati Clinic, April 10, 1880.
[2] Medical Record, April 3.

vomiting, pain in the head, and choleraic diarrhœa. She did not certainly die as she would have died from any other anæsthetic. A peculiar feature of the case was the scanty secretion of urine—five ounces and one drachm in twenty-one hours. As the kidneys, to the eye, appeared normal, and, under the microscope, revealed "acute catarrhal nephritis," the question arises whether this scanty secretion was an effect of the ether, of the condition of the kidneys, or an accidental occurrence.[1] Future observation and experimental research can alone decide. Many years ago, Dr. Emmet called the attention of the profession to the active part taken by the kidneys in the elimination of ether from the system, to the necessity of examining the urine before administering an anæsthetic, and to the great danger when disease of the kidneys exists.[2]

Adding the general statement that hydrobromic ether has been administered with safety about two hundred times, and clinical experience is exhausted. Looked at carefully, it does not seem to justify the enthusiastic confidence in the safety of the agent which some of its friends show. The violent perturbations of the great vital functions of respiration and circulation would seem to enforce distrust of it; and that sometimes one and sometimes the other is affected looks like that irregularity of action and inconsistency of course which have banished chloroform from practice. The rise of the pulse rate from 80 to 120, or even to 160, within a minute, certainly suggests doubts as to a heart, at all diseased, bearing the strain.[3]

Theoretical considerations come up for examination, and are especially necessary so long as clinical experience is lacking. These are chiefly, or entirely chemical. If the dictum of Richardson in regard to the chlorine compounds be true, why would it not hold good for the bromine series? If we disintegrate compounds, and find them safe, in proportion to the innocuousness of their components, and *vice versa*, then an agent, into the composition of which bromine largely enters, can stand in no better, if in as good a position, as one containing chlorine. This was the line of argument pursued in the debate on Dr. Sims's case by Dr. Squibb, and its force is not easily escaped, while the facts he presented then, in regard to the chemical peculiarities of bromide of ethyl, its easy decomposition, and its loose molecular character, cannot but bear with very considerable weight in deciding the question.

Dr. Squibb acknowledges that he is prejudiced against hydrobromic ether. This feeling may influence his opinion, and give tone to his remarks, but cannot affect chemical facts. Yet a fuller and more accurate account of the chemistry of this article is now in order, is, indeed, a necessity, and the profession must look to chemists for it. But what is more urgently needed is a series of experiments upon animals. Those given in Dr. Turnbull's work are meagre beyond description, considering the importance of the subject, occupying less than fifteen lines. We want experiments conducted in the scientific spirit, and with the care and accuracy of the British Anæsthetic Committee. Respiration and circulation should be separated, as in those experiments, and then we shall be enabled to judge how frequently and to what extent each is affected by the inhalation

[1] *Scanty urine* was a prominent symptom after the administration of hydrobromic ether in a case reported by Dr. Donald Maclean, of Michigan, in Medical Record, April 24, 1880.

[2] Gynæcology, 2d ed. p. 746.

[3] [Since this almost prophetic paragraph was penned, a case of death while under bromide of ethyl has occurred in Dr. Levis' Clinic at Jefferson College Hospital. See current number of *Medical News and Abstract*.—ED.]

of bromide of ethyl, and in what direction danger lies. Then further use of it with patients will have a scientific basis which it has not now, and until then, we do not think surgeons will be likely to use it for prolonged operations with Dr. Sims's case fresh in memory. For operations of brief duration the clinical testimony in its favour seems to fully justify its use.

Our task has been executed during a period of greatly renewed interest in and study of anæsthetics; in regard to some the ink has scarcely dried before new facts were presented for consideration or statements had to be modified. This awakened interest in the subject and this rapid investigation of new agents attest at once the great importance of the subject and the earnest desire of the profession for a pleasant anæsthetic safer than any we now have. Such an one is not yet found. Every one must deeply regret that a death should have occurred to shake confidence in an article which promised a realization of our hopes. Yet when we reflect on the number of successful inhalations necessary to prove that a new anæsthetic is better than those already tried, the difficulty of the problem is appreciated; the new candidate must have been used thousands of times before it can rival chloroform or the mixed vapours, and tens of thousands before it can be compared with ether in regard to safety. Were this fact kept in view, there would be fewer journal articles and less dogmatism upon this class of remedies. Is it probable that a perfectly safe anæsthetic will ever be at our command? The time necessary for the proving of new agents makes this very improbable during the lifetime of those who saw the advent of ether and chloroform, and the retrospect we have made is not favourable to an affirmative answer. Disaster has followed the use of all, and the facts now will sustain Velpeau's statement as well as when he made it, and still justify Erichsen's words: "With every possible care it appears certain that the inhalation of any anæsthetic agent is in some cases almost inevitably fatal." The inference is that what has been so universally true in the past will be true in the future, however sad this may be to the philanthropist or to the enthusiastic surgeon. Unfortunately physiology teaches the same lesson: a state of artificial anæsthesia is a state on the borders of death.

The great practical lesson of all facts and all theory is that in the use of anæsthetics no precaution can be superfluous, no care too minute, and no watchfulness too great. J. C. R.

ART. XVI.—*Surgery in the Pennsylvania Hospital. Being an epitome of the practice of the Hospital since* 1756; *including collations from the surgical notes, and an account of the more interesting cases from* 1873 *to* 1878; *with some statistical tables.* By THOS. G. MORTON, M.D., and WILLIAM HUNT, M.D., Surgeons to the Hospital. *With papers,* by JOHN B. ROBERTS, M.D., and FRANK WOODBURY, M.D., late Resident Physicians in the Hospital. Prepared by direction of the Managers of the Hospital. 8vo. pp. 349. Philadelphia: J. B. Lippincott & Co., 1880.

"A HOSPITAL fulfilling its true mission is at one and the same time a house of mercy for the helpless and a school of science on which even the richest are dependent."

Has the Pennsylvania Hospital in its more than century long life ful-

filled its true mission? That it has been a house of mercy for the helpless none will question. That it has been, and is, a school of science can as little be doubted, for its history is the history of the labours of nearly every one of those distinguished men who have, since the days of Rush and Physick, made Philadelphia the medical centre of the country.

Through the liberality of its Board of Managers, and the labours chiefly of two of its present staff (Drs. Thos. G. Morton and Wm. Hunt, Drs. John B. Roberts and Frank Woodbury assisting), there has recently been given to the profession a report of no little statistical and practical value upon the surgery of the house, based chiefly upon the carefully prepared case-records made during the last seven years, but presenting also many facts and figures taken from previous and less complete reports. All or nearly all of the ordinary surgical diseases and accidents, and some of the much rarer affections, are noticed in separate papers of varying length, giving the number of cases, their treatment, with its results, and, at times, rather full abstracts from the record-books. Some of these cases have been previously reported in medical journals, and certain descriptions of operations and instruments have already become familiar to the profession through published monographs and treatises. It is to be regretted that the authors, having done so much work, did not do a little more, and arrange their fifty-two papers so that those relating to kindred subjects should be found together; which, indeed, to a certain, but limited, extent was done.

The amount of material placed at the authors' hands was very great. For at least forty years there have been over a thousand cases annually in the surgical wards, and in this number a very unusual proportion of serious disease and extensive injury.

Ask any one what the Pennsylvania Hospital has been specially remarkable for, and the immediate answer will be "the number of its fracture cases and the methods and results of treatment." As might naturally, then, have been expected, fractures and their results have occupied no small part of the authors' attention in the preparation of the volume before us; and we find that about one-fifth of its 350 pages are taken up in treating of these subjects. Prior to May, 1878, 14,012 fractures had been admitted, one-half of them during the last twenty years. How have they been treated? Shock has been met and reaction induced by the administration of "small repeated doses of nutriment combined with quinine and coffee, with but little alcohol." Immediate adjustment of the fracture is the rule, subject, of course, to the ordinary exceptions; the patient being anæsthetized in some cases for examination and dressing. Incisions are freely made when the swelling is great, and "much stress is laid upon this measure." Two things are insisted upon: "first, the great importance of frequent inspection of the injured part; and, secondly, simplicity of apparatus." "Fixed dressings" are not favoured except in the late stage, "being never resorted to in the early stages of the treatment." Sodium silicate is generally employed; plaster of Paris, though "rather dirty in its application," being preferred where rapid solidification is required, *e. g.*, in cases of delirium tremens. Where else but in Philadelphia would plaster of Paris be put aside because of its being "dirty in its application"? What a trial of patience the "dry earth treatment" must have been during the years in which Dr. Hewson used it in the hospital!

Following the paragraphs on fractures in general are those upon special fractures, a few points in which may claim attention either for their statistical value or as showing the opinions upon various disputed points entertained by the surgical staff.

Seventy-three cases of *fracture of the spine* have been treated during a period of forty-four years; about seventy per cent. of which "are known to have died. Many others, doubtless, succumbed after being removed by their friends. . . . The treatment is always expectant. . . . If any deformity is detected an attempt at replacement is made, but no severe manipulation or operation, such as trephining, has been attempted as far as we are cognizant of the facts."

Fractures of the cranium have proved fatal in nearly one-half of the cases (146 deaths in 305 cases). The bromide of potassium in large doses and purgatives are generally relied upon to prevent cerebral congestion and inflammation. In cases of simple fracture with serious symptoms free exploratory incisions in the scalp are made, and "it is felt that too great stress can hardly be laid upon the importance of this exploratory incision in severe injuries of the head with suspected fracture of the cranium."

In the treatment of *fracture of the clavicle* Fox's apparatus continues to be largely used, though the "postural" treatment is acknowledged to be the best "when it can be enforced."

Fractures of the lower end of the radius are commonly treated with the Bond splint, Levis's new splint having been somewhat employed of late. The existence of "Barton's fracture" is stated to be recognized by the surgeons of the house with the exception of Dr. Levis, who "denies its distinctive character."

Fractures of the shaft of the femur are treated by extension and sand-bags. "Measurement of the limbs in cases of suspected fracture, or as a means of determining results of treatment, is considered of value to a very limited degree . . . (and) has been almost discontinued, for there is no possible method of insuring accuracy when the injured leg may have been a half inch longer or shorter than the other before the receipt of fracture. Great attention is, therefore, to be given to the appearance of the thigh, and deformity avoided by accurate inspection."

In this connection notice may be taken of the paper by Dr. Morton, on *Asymmetry of Limbs*, in which (after presenting in brief a history of the work done by Dr. W. C. Cox and Dr. Wm. Hunt) he reports the results of the measurements made upon 513 boys at Girard College, 272 of whom "showed inequality of the limbs, and in 241 there was no appreciable difference." These measurements were made with an apparatus devised years ago by Dr. Morton.[1]

In the treatment of *fractured patella* Drs. Morton and Levis have for years past used a modified Malgaigne hook, and their opinion of such is evidently very different from that of their colleague, Prof. Agnew, who calls it an "infernal machine."

The "fracture-box" still holds its place as the favourite apparatus in cases of *fracture of the leg.*

Dr. Roberts has contributed quite a lengthy paper on *refracture* in cases of mal-union, believing it to be "the best method of correcting deformity, because it gives relief without suppuration, which is liable to follow drilling, and almost certain to result from the operation of excision." Eight cases are reported treated in this way during the five years from January, 1873, to January, 1878; the results being very satisfactory. It is, we believe, probable that subcutaneous division with saw or chisel will in the future be preferred, except in cases coming under treatment within a short time after union has taken place.

[1] See American Journal of Med. Sci., Jan. 1877, p. 144.

One hundred cases of *ununited fracture and delayed union* are reported as having been under care in the hospital up to May, 1878; thirty-seven of which were operated upon during the last fifteen years, chiefly by drilling and friction. Only one death occurred, in a case of femur-fracture. The histories of several very interesting cases treated in the earlier years of the hospital, as recorded in the old case-books, are given in detail; among them the first seton-case of Physick in 1802, and the case of anchylosed hip-joint upon which Rhea Barton operated in 1826.

Since 1830, 1011 *amputations* have been made, 801 of them for accidental injuries. One in four proved fatal (24.43 per cent.). Respecting the immediate treatment of cases of severity necessitating amputation at once, Dr. Morton says—

"We impress upon the resident physicians, who immediately attend to our patients upon admission, that the treatment of shock is of primary importance, *rest* being the great factor in bringing about reaction. The common practice of giving large amounts of stimulants indiscriminately in all cases, immediately upon the receipt of an accident, is wrong in principle, and should be condemned as not only inefficient but positively injurious. We avoid the use of alcohol, as a rule, and resort to it only in very exceptional cases."

It would be well if these sentences could become as household words to all, professional and non-professional. Just before operation—

"of late years the rule has been observed to give, in all cases, a full dose of quinine. . . . The operation usually performed is that known as the skin-flap with the circular division of the muscles. . . . In knee-joint amputations . . . as the patella now and then becomes hypertrophied, and thus a source of irritation, we believe it safer in most cases to remove it."

The "Pirogoff" operation, resorted to whenever practicable, is seldom, if ever, employed in chronic cases, and rarely in patients over forty years of age.

The Esmarch bandage is believed to be

"more especially useful in operations for the removal of necrosed bone, or where a careful dissection is made for the removal of tumours, etc., rather than for the arrest of hemorrhage during amputations. . . . The ordinary waxed silk ligature is usually employed in securing vessels; occasionally the animal ligature is resorted to, but rarely. Torsion was, at one time, quite commonly used by one of the former surgeons, but on account of the great loss of blood which so often took place before the closure of the vessel could be effected, and often secondary hemorrhage soon after the stump was closed, the method was not looked on with any favour."

Lately the Bonwill engine has been used in dividing the bone, and it is reported that "we think that the application of this apparatus for cutting through the bones in amputations will in time be more favourably received, for there is no doubt but that necrosis in stumps is frequently due to a clumsy saw and the consequent periosteal separation." Simple dressing is favoured, and the "open method" is stated to have yielded excellent results. "Oakum is always used in place of sponge, the latter having long since been entirely discarded."

The report shows most noticeable absence of septic diseases, not a single case of pyæmia having occurred during the past five years. This is believed to be

"due to the very perfect system of forced ventilation by the fan, the scrupulous cleanliness of the wards, and the free use of carbolic acid in our dressings. In addition to this, our perfect system of dressing wounds with flowing water, dispensing with all basins and sponges from the wards, thus averting any possible

contamination, has been the sure means of ridding our wards of this most terrible of hospital diseases, and accomplishing the beneficial results referred to."

During the period from 1875 to (May inclusive) 1879, 108 amputations were made, death resulting in 17 cases. Among these 108 operations were 2 hip-joint amputations, 16 of the thigh, 39 of the leg, 6 at the knee, and 5 at the shoulder. Of the 29 patients upon whom 58 double amputations have been made since 1830, 6 died. Nine hip-joint amputations in all have been made at the hospital, four of which were reamputations. Three of these latter recovered, and one of the primary operations. A phototype is given of the successful reamputations, all of them made by Dr. Morton.

Burns and scalds, of which 160 cases are reported, with 36 deaths, appear to have been treated much in the usual way, no definite opinion being expressed as to the relative merits of the various remedies.

Arterial ligations number 43 (31 on account of aneurism, 11 for hemorrhage, and 1 for elephantiasis), of which 13 terminated fatally. It is both interesting and instructive to notice that of the cases of ligation of the subclavian (2) 50 per cent. (1) died, of the common carotid (9) 66⅔ per cent. (6), of the external iliac (5) 40 per cent. (2), and of the femoral (19) 21 per cent. (4). The single case of ligation of the common iliac recovered, as also did that of ligation of the internal iliac. In the summing up on p. 45, it is stated that of the external iliac ligations *three* died, and of the *eighteen* femoral ligations four died; on p. 44 *two* deaths are credited to the tying of the external iliac, and *nineteen* femoral ligations are reported (two, however, on the same patient), both of which statements are shown by the table on p. 63 to be correct.

"In nearly all the operations the ordinary silk ligature has been used. As early as 1820 Dr. Parrish used a catgut ligature upon the anterior tibial artery. In four of the later cases, however, viz., two of the femoral, one external iliac, one brachial ligation, carbolized catgut was used. Deep abscess and sloughing occurred in one of these femoral ligations, followed by phlebitis and a fatal termination; the external iliac ligation also died; the other two did well. In two cases the aneurismal sac was punctured by a small trocar, and several feet of horse-hair were introduced; both patients died of sloughing of the sac and hemorrhage. In no case has the injection of coagulating fluids been resorted to, nor has electro-puncture been performed. . . . Quite a number of the cases of aneurism have been subjected to compression, but for excessive pain in some cases, and inability to control the circulation as desired in others, this method, after varying periods of trial, was desisted from and deligation of the vessels resorted to. In three cases, however, good results were obtained; in two cases by mechanical and digital compression, and in the other by forced flexion of the limb. . . . The period occupied for effecting the cure in the cases of compression has varied from ten to thirty-six hours."

In two cases, *extirpation of the rectum* has been made for malignant disease. "The first case rapidly recovered from the operation, in fact had not a bad symptom, and obtained a new lease of life without even being annoyed with incontinence of feces. The second died a few days after the operation." Dr. Roberts, in commenting at some length upon these cases, notices the great difference among writers in the stated distance from the anus at which the peritoneum passes from the bladder or uterus to the anterior surface of the rectum, and very justly attributes these discrepancies to the manner in which the measurements were made. Few at the present day will take exception to the expressed opinion that "in selected cases the operation can be done with a reasonable hope of alleviating the distress of the patient and making life endurable."

Of *erysipelas*, sixty-five cases are reported (since 1873), sixty-two of which "were admitted for the disease." The cases were treated in the usual way (largely, it appears, with the tr. ferri chloridi), and five proved fatal; three of these latter being of the facial variety. In commenting on these cases, Dr. Hunt says:—

"The record utterly fails to confirm the theory of any high degree of contagion in the disease itself, and if the contagious elements are in the shape of specific germ spores, upon the diffusion of which the spread of the disease is dependent, then these spores certainly neglected their opportunity."

Of *cancer*, seventy-one cases are tabulated, forty-eight of which were operated on. "In a few cases caustics were used, but there is no encouragement whatever to advocate the replacement of the knife by these agents. . . . Specifics are absolutely useless, both generally and locally."

Since 1870 seventy-two cases of *strangulated or incarcerated hernia* were admitted, twenty-seven of which were operated on, with a resulting mortality of nearly fifty per cent. "The radical operation for the cure of hernia is not now practised in the hospital. . . . The risk of the operation is so great, as also is the uncertainty of any permanent beneficial result following it, that we now prefer the well-fitting hard rubber truss."

Urethral strictures, of which fifty-five are tabulated, were very generally, it seems, treated by gradual dilatation, urethrotomy

being "rarely resorted to. . . . The hospital is not without its experience in most, if not all, of the various methods of treating stricture that have been and are recommended. From time to time these are tried upon appropriate cases, and we think a just estimate is placed upon their value, but nothing has yet arisen in the way of improvement as to induce us to abandon the present prevailing treatment."

In the treatment of rupture of the urethra the catheter is removed after the first two or three days, being retained longer only "in very exceptional cases."

Twenty six cases of *tetanus* are reported, twenty-five of them traumatic. Of these six recovered, an unusual and certainly most gratifying proportion.

"Five of them were kept under chloral in large doses, and one got well under the use of conia. . . . Among the most essential elements to success are isolation, dark rooms, and silence. . . . Nourishing food should be given at stated intervals, and in such a way as to cause the least possible disturbance."

Since the foundation of the hospital one hundred and thirty-three lithotomies have been made, with a total mortality of 14.28 per cent. (19); and nineteen lithotrities, with 10.52 per cent. mortality (2). (How much of the existing feeling on the part of American surgeons with reference to the latter operation is due directly or indirectly to the teachings and practice of Dr. Randolph in the amphitheatre of the Pennsylvania Hospital? Not a little, certainly.)

Of the large *joint excisions* twenty cases are tabulated, with five deaths (25 per cent.). Contrary to the view of surgeons in general, removal of the elbow is not favourably regarded.

"We have on several occasions compared cases that have been treated in both ways, and we have mostly found that the anchylosed limb, provided that the proper angle had been maintained, was the superior of the other both as to strength and to control of movements."

Nor is excision of the knee-joint looked upon with much more favour; and that of the ankle is, in acute cases, altogether disapproved.

"Amputate rather than cut out the joint. . . . The great risk of attempting to save limbs in severe compound injuries of the ankle-joint is strikingly illustrated. We think there is not one of the surgical staff who does not agree in saying that the more he tries the experiment the more he has occasion to regret it."

The short paper on *lacerations, wounds, etc.*, will prove of much interest to that large class in the profession who are frequently meeting with cases of such nature, and who almost as frequently ask, "What is best to be done?" Hot water as a hæmostatic has been used "of late with great satisfaction." In cases of gunshot wound (and this direction is especially applicable to wounds made by small pistol-balls), it is very properly advised to remove the ball if it can readily be found, if not to let it alone; "there is no need to increase the hazard to the life of the patient by undue perseverance in what often may be an unsuccessful effort."

Of the *germ theory* it is very briefly stated—

"whether it will be fully established and recognized or not, remains to be seen, for it is much easier to theorize about it than to prove. . . . In the mean time, however, the practice of cleanliness and care as to both great and small matters that has arisen out of it is productive of much good. . . . There is one unfortunate influence that the theory in question has had, and that is, in inculcating the belief that the sources of all evil to the proper healing of wounds come from without. Hence the possible constitutional origin of local trouble is often lost sight of. In a surgical sense we learn fully to appreciate by practice that as to the human body alone 'all flesh is not the same flesh.' There is a flesh that heals and a flesh that will not heal, a flesh that ulcerates, a flesh that bleeds, and a flesh that sloughs. Weak central organs, diseased blood, vitiated secretions, and vicious habits may, and do, neutralize our efforts as well as bacteria and micrococci."

The use of sutures in cases of scalp wound is very properly advised. "There is nothing whatever to justify the old and deeply-rooted prejudice against sutures in this part of the body." Penetrating wounds of the chest are treated by immediate closure and fixation with adhesive plaster of the injured side. Early use of the joint in cases of sprain seems to be the custom, it being thought certain that anchylosis is thus often prevented. Aspiration of chronic abscesses is very highly commended. "Relief and cures are obtained by it very frequently, and its use, rarely, if ever, interferes with more positive measures, should they become necessary."

Quite a considerable space is devoted to the subject of *transfusion of blood*, an operation which has been made nine times, six times during the past five years; the mediate method having always been employed. In five of the six cases just mentioned, the operation though affording some relief, did not suffice to avert the fatal termination.

The several papers on *painful affection of the foot, elephantiasis, neuralgia and nerve-section*, although of much interest, can only be referred to. And the same must be said of the papers on *joint affections and injuries*, and *gynæcological cases and operations*.

In conclusion we cannot but express the pleasure that the perusal of the work under review has afforded us, and our sense of its value as a *résumé* of what has been and is being done in the oldest and best known hospital of our country; where the treatment of surgical disease and injury is at once scientific, conservative, and eminently successful; where

the attending staff, certainly influenced, perhaps a little hampered, by the traditions of a century, are, as their predecessors ever have been, among the ablest surgical teachers and practitioners, the report of whose labours will command the attention and respect of the medical world.

P. S. C.

ART. XVII.—*Medico-Chirurgical Transactions.* Published by the Royal Medical and Chirurgical Society of London. Volume the Sixty-second. 8vo. pp. lxix., 473. London: Longmans, Green, Reader, and Dyer, 1879.

IN accordance with our custom we shall notice the medical and surgical papers in this volume separately. As analyses of many of these have already appeared in previous numbers of this Journal or in the *Medical News and Abstract*, which is accessible to all our readers, we shall not again refer to them.

Dr. GEORGE THIN, in his paper on the *Pathology of Lupus*, gives the result of his examinations of lupus tissues, which were undertaken with the view of determining, as far as possible, the nature of the so-called *giant-cells* described by Friedländer and others as of constant occurrence in the disease. A careful analysis of these objects (giant-cells), in their different stages and forms, has led him, he says, to form the conclusion that they are not independent organic structures, but that, on the contrary, the wall of the so-called cell is the altered coat of a diseased blood-vessel, that the appearance described as protoplasma is produced by a disintegration of red blood-corpuscles, that the nuclei on the periphery are nuclei of the vascular walls, and that the nuclei of the centre, when they are present, are the nuclei of colourless blood-corpuscles. He bases this opinion partly upon the fact that the dye eosin stains the giant-cells of lupus as deeply as it does the red blood-corpuscles, the striped and unstriped muscles and bloodvessels—tissues for which it has been shown to have a special elective affinity, and partly upon certain microscopic appearances, which we shall let him describe in his own words:—

"If we search," he says, "for the early stage of development of the giant-cells in parts of the healthy or comparatively healthy tissue adjoining the lupus infiltration we find the following transition stages: Giant-cells are found in which the contents of the cells are homogeneous at one part and granular at another; others in which the contents are entirely homogeneous, whilst the wall and processes fulfil the characteristic requirements of the giant-cells, the nuclei, in this case, being limited to the wall, but still differing in no respect from the nuclei on the wall of the granular giant-cell. In some of these cells with homogeneous contents the likeness of the whole structure to a bloodvessel becomes apparent, and occasionally the wall is found to show the characteristic muscular coat of an artery. Going another stage backwards we find a giant-cell with homogeneous contents and red blood-corpuscles in the centre of the homogeneous mass—sometimes in considerable numbers—the wall and its relations still answering to the requirements of the giant-cell. In other sections of giant-cells we find the coats of the original blood-vessels still represented, the inner coat being represented by the nuclei of its endothelium, and the middle and outer coats by considerable thicknesses of characteristic tissue."

Instead of the expression giant-cell the author, therefore, proposes to substitute the term diseased bloodvessel.

The patient, whose history is related by Mr. HUTCHINSON, in his *Narrative of a Case of True Leprosy in which complete recovery has taken place*, was a woman, aged 71 years, who was born in England. When thirty-two years of age, being at that time in excellent health, she emigrated to Jamaica, where she lived eleven years. While there fish seems to have entered largely into her diet, a fact which tends to support Mr. Hutchinson's opinion that the malady is due solely to fish, and that its special cause is, probably, fish. After the disease had made some headway she returned to England and placed herself under Mr. Startin's care at the Hospital for Skin Diseases. Subsequently she came under the charge of Dr. Addison at Guy's Hospital. Drug treatment appears to have been of little service, and she soon left it off. Some improvement, however, followed the use of port wine and champagne. At the time of writing the patient is described as young looking for her years, but showing various conditions which have resulted from the leprosy. Her skin, although nowhere quite anæsthetic, except in the region of the right ulnar nerve, is in many parts deficient in sensation and dusky in tint. All tubercles have long since disappeared, and, both as regards skin and nerves, the author considers that reparation has taken place as far as it is possible. Her right eye is inflamed and the cornea ulcerated with deposit in its structure, and much persistent conjunctival congestion.

Dr. FREDERICK TAYLOR, in his paper *On the Condition of the Skin in Tinea Tonsurans*, gives the result of some microscopic examinations which he undertook for the purpose of determining whether the fungus upon which the disease depends is confined to the hair itself or whether it spreads into the structure of the root-sheaths and hair-follicles. The skin examined was obtained from the head of a child who had died of a tumour of the brain. Numerous sections were made from it, some of which were stained in logwood and some in picro-carmine. The result of his examinations are in favour of the statements of Küchenmeister, and opposed to those of Kaposi in reference to the implication of the root-sheaths. The hair-follicles, papillæ and root-sheaths, the cutis, subcutaneous tissue, and mucous layer of the epidermis, were entirely free, while the only parts invaded were the hair proper, and perhaps the horny layer to a slight and superficial extent.

Mr. GEORGE GASKOIN, in his report of *A Case of Morphœa*, makes some remarks in regard to the points of resemblance between this disease and leprosy, although he refrains from expressing a positive opinion as to their identity. The patient was an unmarried woman, of purely English nurture and extraction, aged 24, who, in addition to nodular masses on the face and chest, presented several maculæ of a "dark negro tint" on the arms and legs. Her health is said to have been always languid and disturbed but with no special ailment. Pain, anæsthesia, and pruritus, were scarcely or not at all observed, and there was only a trifling degree of local heat at times.

Dr. W. R. GOWERS contributes a long and instructive paper entitled *A Study of the so-called Tendon-Reflex Phenomena*. Under this designation are considered the two forms of muscular spasm first described by Erb and Westphal, viz.: 1. The movement which occurs under normal conditions at the knee-joint when the patellar tendon is struck. 2. The movement which occurs at the ankle-joint in certain forms of disease of the spinal cord when the extensor muscle and tendon are suddenly put upon the stretch.

In order to ascertain what are the variations in the knee-reflex under normal and abnormal conditions, Dr. Gowers examined 300 individuals, of whom 150 were not suffering from any paralytic condition of the lower extremities. Of these some were, as far as is known, in perfectly normal health, but the majority were the subjects of simple epilepsy. Of the whole 300 cases the movement was entirely absent on both sides in seventeen. Four of these seventeen individuals were suffering from locomotor ataxy, a fifth had atrophy of the optic nerves, and commencing ataxy was suspected. Of the remaining twelve, two were under treatment for paraplegic weakness of the legs, one had had an attack of right hemiplegia, one was suffering from mental disturbance and weakness with auditory nerve vertigo, one from tumour of the brain, and one from chorea, and six were epileptics. Almost all of them were poor walkers. In three cases only was the reflex absent in one leg, and present, although slight, in the other. In twenty-seven cases of hemiplegia from cerebral disease the reflex was equal in the two legs in thirteen of the cases, and unequal in fourteen. In the latter, without an exception, the excess of movement was on the paralyzed side.

In ninety out of one hundred individuals whose walking powers were reasonably gone, and who were examined with special reference to this point, the range of movement of the foot which could be excited by such a tap as ordinarily develops the maximum effect was found to be between one and three inches. The reflex was entirely absent in no patient with good walking power, although in four it was slight, not more than half an inch. In only six did it exceed three inches.

Dr. Gowers's next observations were directed towards determining the question whether the contraction of the quadriceps which follows the tap upon the patellar tendon is a true spinal reflex, or whether it is a simple effect of the blow on the tendon upon the fibres of the muscle, causing their sudden contraction. By means of a revolving drum, the writing-pen of which was attached to the foot, he was able to demonstrate that the muscular contraction occurs at such an interval after the stimulating tap, as, according to physiological data, would be needed for the processes involved in the necessary spinal reflex action, or, in other words, in about ten seconds, the shortest interval being nine seconds and the longest fifteen seconds. The tracing sometimes showed another interesting character, and that is a slight rise and a fall, often more considerable than the rise, between the stimulation and the movement which the author believes to be due to a slight contraction and subsequent relaxation of the muscles. The interval between them is not enough for the occurrence of a spinal reflex action; and there can be little doubt, he thinks, that they are the direct effects upon the muscular fibres of the blow on the tendon. The sudden slight tension upon the fibres causes a brief slight contraction, succeeded by relaxation, and followed by the strong contraction which results from the spinal reflex.

The visible phenomena being thus, those of a spinal reflex, the integrity of the path to and from the cord, and of the reflex mechanism in the gray matter of the cord, are necessary for its production; a damage in any one of these situations to the sensory fibres, the motor fibres, or the gray matter, may be expected to prevent its occurrence. Facts are in perfect accord with this conclusion. Thus: 1. The phenomenon is absent in most cases of locomotor ataxy, in which, as is well known, the region of the cord damaged is that, and may be that only, through which the fibres of the

posterior nerve roots pass. 2. Damage to that part of the anterior gray cornu of the cord to which the quadriceps extensor is related prevents absolutely the production of the reflex. It is usually lost also in cases of atrophy of the lower extremities in which the quadriceps extensor is in any considerable degree involved, and often when its affection is slight, and this in cases in which there is not the slightest impairment of sensation. The reflex is lost, not only in ordinary cases of atrophy but also in pseudo-hypertrophic paralysis, especially in the latter stages of the disease, when the quadriceps extensor is always considerably damaged. In a few cases of locomotor ataxia the preservation of the knee reflex has coincided with such a slight degree of damage to the fibres of the posterior nerve-roots as does not involve appreciable loss of sensation. In some of these cases the lightning pains, which generally occasion so much distress in this disease, were also not as marked as usual.

To produce the ankle clonus it is only necessary to make a sudden dorsal flexion of the foot by pressure with the hand placed against the ball of the foot. This will make the tendon of Achilles tense and be almost instantly followed by a brief contraction of the gastrocnemius sufficient to move the foot and hand a little in the direction of extension, and this ceasing, the pressure of the hand being kept up, another similar contraction follows, and so on until the hand is removed. This phenomenon occurs commonly in those diseases of the spinal cord in which there is reason to believe that there is sclerosis of the lateral white columns, either primary or secondary to diseases of the cord higher up, or secondary to a lesion in the brain.

By means of the revolving drum, the writing lever being attached to the side of the foot, it was ascertained that the average number of contractions per second is nearly six, the variations being in the whole series of cases examined between five and seven, and that the average duration of each movement, and the interval between these contractions of the gastrocnemius, is about the sixth of a second.

In order to settle the question whether or not the ankle clonus is, like the patellar tendon reflex, of reflex nature, which its constant association with certain forms of spinal disease would seem to indicate, Dr. Gowers performed a series of experiments through which it will, unfortunately, be impossible for us to follow him. He found, however, that a contraction of the gastrocnemius could be produced by a gentle tap on the tendon of Achilles when the foot was only moderately flexed. The interval in this case between the stimulus and the movement was in most cases about .04 of a second, which is a period of time insufficient for the occurrence of a reflex process. "But," the author says, "whatever is the mechanism through which the single contraction is excited by the tap on the Achilles tendon, is certainly the mechanism by which the ankle clonus is excited." The conclusion therefore seems a necessary one to him that these clonic contractions are the result, not of reflex but of direct stimulation of the muscle by its sudden tension. It is true that the clonus occurs only in cases in which there is the strongest reason to believe that there are organic changes in the cord. But this fact is not evidence he thinks of its spinal origin, because it is quite conceivable that diseases of the cord either by the withdrawal or by the excitation of a central influence, may leave the muscles in a condition to respond in an abnormal manner to direct stimuli, just as we see the muscular fibres in progessive muscular atrophy quiver readily when struck. It is certainly not usual to regard this quivering as therefore a spinal reflex. J. H. H.

Next we turn to the surgical papers, and here as in the medical the opening paper is on Croup and Diphtheria. It is entitled "*Tracheotomy in Membranous Laryngitis*," and is written by Mr. ROBERT WILLIAM PARKER. If we may judge from this paper Mr. Parker is an acute observer, and a surgeon fertile in expedients. He proposes and figures three instruments which are both ingenious and valuable: one is a modified tracheotomy tube substituting a new and certainly a more accurate curve in the tube; another is an "automatic retractor" by which the edges of a wound may be held apart and an assistant be dispensed with; the third a plug to prevent contraction of the aperture when the tube is first removed and so form an obstacle to its re-introduction. The change in the curve of the tube is the most important and valuable, its objects being especially the avoidance of ulceration of the trachea by pressure. We also approve of the beveling of the end at the expense of the anterior wall, as it not only diminishes the danger of friction but materially facilitates its introduction without a plunger or guide. We note too with commendation that he advises anæsthesia, the use of large-sized tubes, the alkaline and steam spray and regular removal and replacement of the outer tube, or better still the use of two tubes in alternation. In fact the paper is full of useful hints.

In carrying out the after treatment he uses an extemporaneously inclosed bed, which is readily made, and is as efficient as it is cheap. Four wooden or iron rods are tied to the legs of an ordinary bed or crib. These are connected at the top by cross pieces and sheets thrown over all, leaving an opening for access to the patient and for light.

His systematic and, as it seems to us, rather harsh treatment of the trachea by frequent and repeated cleansing by "large feathers twirling them about in the trachea," or by a catheter, following the membrane even "down deep into the chest," is more doubtful; and we certainly do dissent from his closing dictum—"the presence of membrane in the trachea in a fatal case of membranous laryngitis after tracheotomy, must be regarded as evidence of want of due care on the part of the surgeon in charge, just as much as would the presence of a piece of gut in the inguinal canal after herniotomy, or a calculus in the bladder after the operation of lithotomy."

Mr. RICHARD BARWELL next describes *Three Cases of Distal Ligature of the Carotid and Subclavian Arteries for Aneurisms involving the Innominate Artery.* In the volume of Transactions preceding this he has already related a similar case, and given from other authors six additional cases. Adding the three now related, and one by Dr. King, of Hull, we have eleven cases in all, four of which have been done by Mr. Barwell, and of the three successes out of eleven cases all are his; surely a very unusual piece of good fortune—and good surgery. It is needless to give the operation and subsequent details save to note, besides the happy issue, the marked influence of menstruation for ill, the pulsation being greatly increased both before the operation and during recovery; that the operations were done antiseptically; and especially the small force used in tying them—a force of less than two pounds. Catgut was the material, and the little force used was the result of dynamometrical experiments, which showed that an E string of the violin would cut the two inner coats if tied with a force of three pounds, but none if with only two pounds. Mr. Barwell's cases are fully reported in the *Monthly Abstract* for 1879, p. 174.

As if to crown his name with added and well deserved lustre, Mr. BARWELL, later on in the volume, reports another almost analogous and, strange to say, successful case of *Deligation for Aortic Aneurism of the right Carotid and Subclavian Arteries, with a new species of Ligature.* The case fell into his hands, two months after the first paper was read, and soon afterwards he did this novel and interesting operation. His reasons for it are given at length. From the anatomy of the origins of the three great trunks from the aorta as well as from the character of the blood stream, as shown by the behaviour of emboli, etc., he divides the aorta into two great districts—the right and the left aortic districts divided "by a somewhat curved line running from the outer or right side of the aortic opening to the left carotid orifice," and if the portion of the aneurism can be defined in the one or the other district the corresponding vessels should be tied. The diagnosis is difficult and often impossible, but most important in those cases in which it can be made, by observations as to pressure on the bronchi, the sphygmograph, the venous congestion, the voice, the seat of pain, etc. He also refers to two cases preceding the present one in confirmation of his theory.

The unreliability and variability of catgut he shows is probably due to the fact that putrefaction in water is the first step in its preparation. In searching for a substitute the happy idea occurred to him "that the most fitting substance with which to surround an artery would be *arterial tissue.*" Accordingly he procured the aorta from oxen, placed them in a three per cent. solution of carbolic acid, and cut from the middle coat *flat bands* for ligatures, this form being used to avoid cutting through the two inner coats. The details of its preparation are given, and the results of experiment on the lower animals showed that it was highly suitable for its intended use. The entire case is an instance of ingenious reasoning, well-devised experiment, and excellent surgery, crowned by its highest reward—an unexampled success. A full abstract of this case was published in the number of this Journal for July, 1879, p. 269.

Mr. W. B. DALBY next writes *On Disease of the Mastoid Bone.* Surely he should have said "Diseases," for it is scarcely fair to include malignant diseases, Mastoid Disease properly so-called, and necrosis of the entire temporal, under so misleading a title. The first case is a strong argument for the local origin of malignant disease. In March a woman æt. 32 picked her ear with a hair-pin and ruptured the tympanic membrane (soon after which Mr. Dalby saw her), an accident followed in a few days by suppuration, a month later by a polypus and facial palsy. In July the mastoid became involved with an appearance of malignancy, and she died in November from well marked cancer. Mr. Dalby has collected also six other similar cases with definite histories of a local origin, followed by cancer, without any apparent predisposition.

The case of mastoid disease proper follows the usual history, and happily ended in recovery as a result of trephining a month after the onset of the disease. One sentence in it should be well pondered—"I cannot but reflect that I have never, either in my own practice or in that of others, known the mastoid cells to be opened before it was needed."

Ophthalmic surgeons will be especially interested in a paper by Mr. JONATHAN HUTCHINSON *On Ophthalmoplegia Externa, or Symmetrical Immobility (partial) of the Eyes with Ptosis.* The name indicates ophthalmic paralysis or weakness of all the ocular muscles, so that the lids droop and the eye-balls become gradually limited in motion and some-

times absolutely motionless. In the last volume of Transactions a similar disease affecting the iris and ciliary muscles, through disease of the ciliary ganglion, Mr. Hutchinson has designated as ophthalmoplegia *interna*. In the present form of disease the internal muscles also are involved. Both diseases are probably closely allied to what is known as progressive muscular atrophy, and in many, if not most cases, they seem pretty clearly due to syphilis. Specific treatment produced marked benefit, but none were cured. Seventeen cases are given.

Mr. CHRISTOPHER HEATH contributes a very interesting paper *On the Diagnosis and Treatment of Ruptured Bladder*. The patient had been thrown down on his back by a companion, whose elbow hit him "in the stomach." He was sent to the hospital over twenty-four hours later by a doctor who had drawn a few ounces of bloody urine, with a diagnosis of hæmaturia and retention. Mr. Heath diagnosed ruptured bladder, and calls attention to the influence of the respiratory movements on micturition, an influence not visible when the bladder walls are intact. Abdominal section was performed at once by the antiseptic method, but the carbolic spray gave out before the operation was ended. The rent in the bladder was sewed up by a continuous catgut suture. He did well until the fifth day after the accident, and died on the sixth. Local peritonitis about the abdominal wound for two inches, six ounces of blood in the recto-vesical pouch, peritonitis in the coils of the intestines over it, and a gaping of the lower part of the wound in the bladder, were found at the post-mortem. Mr. Heath then discusses the various procedures proposed and the cases actually treated, both in England and the United States, including the methods of paracentesis, abdominal section (first proposed by Prof. Gross), catheterism both of the bladder and peritoneal cavity, lateral lithotomy (first suggested by Dr. Stephen Smith), and tapping the recto-vesical pouch. Four recoveries are cited, two by catheterism, one by abdominal section, and one by lateral lithotomy. The difficulty of sewing up the bladder, especially if the rent be posterior, as it is apt to be, is very great indeed, even with many and trained assistants, and as abdominal section has little if any advantage over paracentesis in evacuating the fluid, and is less effective in drainage than tapping the recto-vesical pouch, he rightly rejects it. His conclusion not only commends itself to common sense, but the method he urges is also simple and convenient, and can be done by every practitioner (a point of no small importance), viz., that cases of ruptured bladder should be treated so far as operation goes by catheterism and washing out, both of the bladder *and the peritoneal cavity*, reserving lateral lithotomy for the cases in which the catheter cannot be introduced through the rent into the abdominal cavity. If the practice needed any reinforcement it may well be found in the remarkable success recently reported by Mr. Keith in ovariotomy (97 per cent.), due largely, if not chiefly, to the fact that he *thoroughly* cleanses the peritoneal cavity as well as to the use of the antiseptic method.

Four papers out of twenty are on ophthalmic subjects, among them being next *Some Remarks on* 150 *Operations for Extraction of Cataract*, by Mr. CHARLES HIGGENS. He compares three methods of operating—the small flap section, linear section, and oblique corneal section, giving the merits and defects of each. His testimony as to the value of iridectomy is decided and very just. For the details we must refer to the paper itself.

Mr. J. W. HULKE relates a very interesting *Case of Secondary Trephining for Traumatic Abscess of the Brain with Recovery*. An errand

boy, æt. 15, stumbled against an iron fence, grazing the forehead pretty deeply, but not to the bone. He continued at his work for a month, although suffering constant frontal pain. He then began to vomit, and soon afterwards to be more or less comatose. Seven weeks after the accident incomplete hemiplegia of the left side was observed. The pulse was but 48, and the temperature only 97.8° F. Mr. Hulke trephined and found a "small starred crack" in the outer table only of the frontal bone. After the dura mater was exposed and no pus found, a fine trocar connected with an aspirator was thrust in about an inch, disclosing greenish pus, and through the incision then made ʒiij–iv were evacuated. He recovered slowly and became both blind and epileptic. The latter trouble was cured, but the former persisted.

The paper *On Perforating Ulcer of the Foot*, by Mr. Wm. S. Savory and Mr. Henry T. Butlin is a *model* of what such paper ought to be. First, five cases are related in sufficient and accurate detail, with one coloured plate illustrating the disease macroscopically and two more microscopically; next the disease is briefly but satisfactorily described and its treatment considered; then its pathology is discussed, especially in the light of the facts revealed by the cases related, and finally a chronological bibliography from 1837 is given, including sixty-two separate titles. Among these are noted a few works inaccessible to the writers, and we observe among them, with some surprise in a great medical centre such as London, a number of Thèses de Paris, the "Medical Record," and the "Med. and Surg. Reporter." A specially commendable feature follows the bibliography, viz., a statement, again following the chronological order, of the new facts or opinions of each author, so that we can follow the current of medical opinion or discovery intelligently. All this is clearly and concisely done in the brief limit of eighteen pages. As to the disease itself, we can only point out that the authors have added to the proofs of its being due to a nerve lesion—a view but lately advanced.

Prof. G. M. Humphry relates a very interesting case of a *Tumour in the Bladder removed by Perineal Incision, with complete Recovery*. The patient was a man æt. 21, whose earlier symptom was intermittent hæmaturia, with pain and straining, but without casts or symptoms of stone. After some six weeks a firmish mass could be felt above the pubes and from the rectum. His pain and emaciation were so threatening that the lateral operation for lithotomy was done, and a tumour as large as an orange, with a pedicle as thick as the finger attached near the right ureter, was removed partly by the finger and partly by the forceps. Intense pain returned and continued for two months, so that it was presumed that the disease had returned; but he then began to mend, and after a month or so more he recovered and remained well after over a year. Mr. Humphry then gives in brief Billroth's well-known case (the only other similar case), and then discusses in general the subject of vesical tumours. He divides them into the papillomata, myxomata, fibromata, and the cancers, and studies the pathological anatomy of each. Finally, he urges in cases of serious or protracted and doubtful disease of the bladder, that perineal incision and digital exploration be more frequently resorted to. We cannot, however, refrain from hoping that with improved instruments we may soon be able to make such diagnoses by the urethra rather than by a serious operation.

The last paper we notice is *On the Movements of the Eyelids*, by Dr. W. R. Gowers—a paper of more than usual interest both to the oculist

and the neurologist, and even to the artist. So far as we know, no one before Dr. G. has analyzed minutely the movements of the lids from a medical standpoint, and writers on artistic anatomy also have slurred it over in a sentence or two. One point Dr. G. has failed to note, although of some importance. He seems to have studied the movements of the eyelids exclusively on others. Many of them can be very well studied on one's self; but in doing so we must remember that, if only one looking-glass be used, the conclusions will be much modified by the fact that the reflecting looking-glass will occupy a very different position from the observer's eye, as it must move about with every change in the visual axis so that we can see our own eyes. *Two* such glasses should be used, one fixed on a level with the eye and directly in front of it, which will represent the observer, and a second movable one, which will reflect to us the image in the first glass. He has not only forgotten to call attention to the fact that the palpebral fissure varies considerably in width on the two sides in almost every person, but in noting the normal position of the lids we think he is clearly wrong. He says it "is such as to leave the cornea and iris unconcealed;" and again: "At the junction of the two [the sclerotic and cornea] is a depression which may be called the sclero-corneal sulcus, and in this, in most persons, the edges of the eyelids rest when they are separated." For the lower lid, when the eye is directed horizontally forward, this is an exact statement; but the edge of the upper lid covers a considerable portion of the cornea below the sulcus, sufficient to conceal the upper half or two-thirds of the breadth of the iris from its outer to its pupillary margin and sometimes even to this margin. And still later he says: "The upper lid follows the movements of the eye-ball, ... the edge being commonly maintained in juxtaposition to the edge of the cornea"—a statement still more erroneous, for the relation of the edges of the lid and of the cornea vary considerably in different positions. The two borders of the iris are the only perfect circles in the body, and it always produces an unpleasant effect artistically (an effect which, in spite of Dr. Gowers's statement, is fortunately rare) when the upper lid allows of its complete exposure.

The movements of the lower lid are first considered as they are the simplest. When the eyeball is at rest the lower lid is elevated by the orbicularis and falls by its own elasticity having been put on the stretch over the prominent cornea. When the eyeball is moved the lid follows the ball in its upward and downward movements, but the ball always gains on the lid in both directions. Depression of the lid is effected by the pressure of the prominent cornea, and elevation by the pressure of the lower convexity of the ball. It can be both seen and felt, and produces the same effect even in facial paralysis, which destroys the only muscular factor that might be supposed to effect this movement.

The movements of the upper lid are more complicated, as we have two muscles. Gentle closure, he states, is effected by contraction of the orbicularis, with a relaxed levator, and opening by the levator, with relaxation of the orbicularis; the recti, and therefore the position of the ball, being unchanged. In forcible closure the mechanism is the same, except that the superior rectus is in contraction instead of inaction. Here again we think his observation faulty. The normal attachment of the lids is below the equator of the eye and about on the level of the lower margin of the pupil. When the lids are even gently closed, the upper lid, as it were, hooks over the projecting cornea and so elevates the ball (*e. g.*, in

sleep), and all the more so in forcible closure and without the action of the superior rectus. Moreover, while the lids are forcibly closed, the balls can be directed up or down as we choose. When gently closed, however, if we look down they are thrust open by the corneal projection, or if we look down with the lids open, it is almost impossible to close the lids without first elevating to some degree the eyeballs. His physiological reasons, therefore, for considering that there are two different centres—one for the gentle and one for the forcible closure of the lids, based on their different conditions in gentle and forcible closure—seem to fall, and the theory certainly does not commend itself to us on *à priori* grounds. Pathologically it is disproved also from cases of paralysis of the seventh, when the orbicularis is paralyzed. On endeavouring, no matter how forcibly, to close the eyelids, the levator is relaxed and the lid falls partially, but does not meet the lower one and so cover and wash the cornea. But with this, when the paralysis first occurs, there is no contraction of the superior rectus as called for on Dr. G.'s theory. It is a trick that is acquired by education; the reason for its acquisition being the need of wetting the cornea by the tears in order to keep it transparent; and as the lid does not fall so low as to hook over the cornea, the ball has to be lifted by the rectus.

Again, his statement that when the ball is depressed the upper lid can be raised "scarcely at all" is incorrect, for not only can it be raised, but a large margin of the sclera can be exposed—as large as when looking straight forwards, if not even more. His pathological arguments in favour of a different mechanism for elevation of the upper lid after closure, and for its elevation along with elevation of the ball, are better founded. He gives three cases of paralysis—one of double ptosis—to illustrate the fact that, while looking straight forwards the upper lids cannot be elevated, yet if the balls are elevated the lids are also. In the other two (illustrated) there is paralysis of the left third nerve and left inferior rectus, and they show that on looking down the lid falls on the normal side, though it does not on the paralyzed, the levator not relaxing: and yet, on closing the lids, the upper one falls in the natural manner, the elevator in this case relaxing naturally. W. W. K.

ART. XVIII.—*Japanese Health Reports.*

1. *First and Second Annual Reports of the Central Sanitary Bureau of the Home Department of the Imperial Japanese Government*, June 30, 1877. By Dr. NAGAYO SENSAI, Director of the Central Sanitary Bureau. Pp. 84 (with numerous tables).
2. *Report of the Director of the Central Sanitary Bureau to H. E. the Minister of the Home Department on Cholera Diseases in Japan during the 10th year of Meiji* (1877). By Dr. NAGAYO SENSAI, Director of the Central Sanitary Bureau.

1. THE progress of other divisions of the human family in what is called "civilization" has often been assisted by transplanting various improvements which together constitute the pre-eminent culture of the Anglo-Saxon; but few of these onward strides in the advancement of a race have been more remarkable than the one chronicled in the former of these essays.

That Japan should have the wisdom to prize, and the energy to pluck so ripe a fruit of our best nineteenth century development, as the Sanitary Bureau, is certainly a noteworthy event in the world's history, and should be pondered well wherever legislative authorities still delay the establishment of Boards of Health.

The volume before us embraces the period from the 1st of July, 1875, to the 30th of June, 1877, but a brief sketch of the Bureau from its inception is prefixed to the body of the Report. From this it appears that the Imukioku or Bureau of Medical Affairs was established in June, 1873, in connection with the Department of Education, and that one of its earliest duties was to draw up a preliminary sanitary code. This code was presented to the Dai-jo-Kwan (Central Government office) in December of the same year for approval, and consisted of seventy-six articles. Of these articles, 1 to 11 relate to the administration of the sanitary affairs of the Empire, to the organization of local sanitary offices, and to the appointment of their officers; articles 12 to 36 to the course of study to be followed in the medical schools; articles 37 to 53 to the examination of candidates for certificates authorizing them to practise as physicians and surgeons; and 54 to 76 to the examination of candidates for license to enter into business as apothecaries, and also special rules for the sale and handling of poisonous medicines and those which are of a powerful nature. At the same time it was suggested that since the proposed code was nearly identical with those of Europe and America, and therefore unsuited to the actual condition of country physicians, only a portion of its provisions should at first be enforced. In March, 1874, this code was ordered to be gradually put into operation in the three cities of Tokio, Kioto, and Osaka, and in the same month the Government Laboratory for sanitary matters was founded in Tokio. In June, 1874, a central office for collecting and keeping pure and effective vaccine lymph was established in Tokio, and in September of the same year regulations respecting compulsory vaccination were proclaimed throughout the Empire. In December, 1874, the selling or keeping adulterated quinia, or iodide of potassium was forbidden by special edict.

"This order was given because, although circumstances rendered it impossible to at once prevent the importation of all kinds of either adulterated medicines or those of inferior quality, yet it was found to be absolutely necessary to take measures to insure that these two particular kinds of medicine should be good and pure, as they are most extensively used, and large quantities were continually being offered for sale either adulterated or of inferior quality. It was at the same time notified by the Department of Education to these cities that in the event of apothecaries being unable to distinguish the quality of any medicine they should be at liberty to apply to one of the government laboratories and have them analyzed without any outlay therefor to themselves."

In February, 1875, examination under government authority of all persons commencing the practice of medicine in the three chief cities was ordained, and in January, 1876, this order was extended to all the *ken* or prefectures of the Empire. About the same time examination of candidates for license to practise as apothecaries was enforced, and reports of deaths and infectious diseases were required of medical practitioners. In March, 1876, twenty other kinds of medicine were added to the list of those which must be kept pure and unadulterated, and in April of the same year the Home Department ordered that in certain cities and prefectures "a system for the inspection of public prostitutes was to be introduced in places where brothels existed." In the same month a magazine

called the "Yei-sei-Kioku Zassi," a record of the Central Sanitary Bureau, was established in order to give the public a knowledge of sanitary affairs in Europe and America.

Dr. Nagayo explains that these various steps were taken in a somewhat irregular sequence, because at first only about 21 per cent. of the physicians followed the European system of treating disease, and even of this small number those who had received a regular medical education were only two or three out of ten, while all the rest were still adhering to the old Chinese and Japanese systems, so that it was necessary to gradually educate a body of medical men who had sufficient technical and scientific knowledge to carry out the provisions of the proposed sanitary code. As he wisely remarks, "the total change of the medical education of a country is a very difficult task, and results cannot reasonably be expected in a short time." That so much has actually been accomplished in so brief a period is perfectly wonderful, and indicates an almost incredible capacity for adopting and improving imperfect means as well as an equally stupendous executive ability in the ruling spirit of the Central Sanitary Bureau.

The body of the work is made up of special reports, the first of which, accompanied by elaborate tables, is that in relation to the rate of mortality and sickness. Table C, facing p. 20, shows the death-rate of the various cities and districts (except one prefecture) from the chief groups of diseases. The population, according to the census of 1876, excluding the district from which no report was received, being 32,812,116, gives a mortality per 1000 (not a per cent. mortality as indicated in the table) of 2.92 or 5.84 for the entire year. This extremely small death-rate shows, as admitted by Dr. Nagayo, that the returns are very incomplete, but they are nevertheless valuable in showing approximatively the relative frequency of causes of death.

The next report is in regard to Infectious and Contagious Diseases, which, it is stated, are well known and recognized by the people as extremely dangerous, although the utmost superstition prevails respecting the proper means of guarding against them.

"The lower class still believe enchantments or supplications to the gods to be the only efficacious remedies. Therefore, when an infectious disease breaks out or is imported it often spreads without check over the whole country."

The third report, in regard to vaccination, informs us that it was the earliest sanitary measure introduced with great success into Japan, being first practised by Dr. Monnik, a Dutch physician at Nagasaki in 1849.

The fourth section treats of hospitals which differ from those in Europe and America in being chiefly resorted to by the wealthier classes. The first hospital in Japan was established by Tokugawa Shogun at Nagasaki in 1861, and there were in 1877 106 hospitals, of which 64 were public, 7 General Government Institutions, and 35 private. To these may be added 53 branch hospitals, lock hospitals, charitable hospitals for the poor, etc., making a grand total of 159.

Section fifth gives a brief account of the efforts towards "Prevention of Venereal Diseases and Inspection of Prostitutes," which until April, 1876, were confined to the sea ports of Yokohama, Nagasaki, and Kobe. According to the appended tables, it appears that during the year from July 1st, 1876, to June, 1877, there were examined in the two hospitals of Hiogo *ken* (city) and one of Tochigi *ken* 12,913 public women, of whom 1174, or 9.09 per cent., proved to be diseased and were placed under treatment.

Section sixth is devoted to "The Government Control of Medicines. (A) The control and examination of medicines in general. (B) Manufacture of medicinal chemicals. (C) Preparation and sale of patent medicines and of those whose composition is not publicly known." There are many points in this section worthy of note, approval, and even of imitation in our own country, but want of space forbids us to dwell upon them.

Section seventh, On Physicians, Apothecaries, and Local Sanitary Officers, informs us that in June, 1876, the number of medical practitioners in Japan was estimated at 23,284, of whom 21 per cent., as already mentioned, were practising medicine according to the European system. In the following year ending June, 1877, "the total number of physicians reported as practising in all cities and prefectures (prefecture of Kagoshima excepted) was 31,261, which bears a ratio of 0.91 to every 1000 of the population of the Empire. Out of this number there were 20,568 physicians following the Chinese system; 6602 the western (European), only 200 of whom were duly qualified by examination; and 4098 following the mixed system." This apparent increase in the number of medical practitioners was chiefly due to more complete registration.

The total number of apothecaries was returned during the year ending June, 1877, as 5993, of whom 22 had been licensed after examination; 16 of the whole number followed the Japanese system, 632 the Chinese, 35 the western, and 5288 a mixed system. The proportion of apothecaries was 0.17 in every 1000 persons, or 0.86 in every 1000 families.

The number of local sanitary committees appointed during the year ending June, 1877, was 321. Some of these were chosen from amongst the physicians and others from amongst the district officers to supervise sanitary improvements as extra duty.

Section eighth treats of the Analysis of Mineral Springs. Of these 674 are reported to exist, and 50 among them have been examined.

A valuable appendix, containing the text of various government notifications and instructions, is added, and contains many items worthy of favourable notice did space permit.

Although occasional orthographical errors and infelicities of diction may be detected by a critical reader, yet we cannot but acknowledge that, under the circumstances which surround its origin, the plan, the literary execution, the paper, typography, and press-work of this volume, being all such as would do credit to a government, a medical officer, and a publisher in London or in Philadelphia, combine to render it a marvel in the history of medical literature.

2. According to the author, Dr. Nagayo Sensai, the first Japanese record of Epidemic Cholera dates back fifty-six years, to 1822 of our era. This outbreak was so severe that members of almost every family were attacked, and in many instances all the members of a family were carried off. Several celebrated physicians of the capital (Yedo), after observing many cases, pronounced it true Asiatic cholera. This epidemic probably arose from cases imported on Dutch ships coming to Nagasaki from Java, where it had been raging.

A milder epidemic occurred about twenty years later; but another most serious outbreak took place in 1858, and lasted nearly three years. From the beginning to the middle of August, 1858, several thousand persons died daily, and the total number of deaths in Yedo at the end of August was estimated at over one hundred thousand. "In Nagasaki the people were

quite in dismay; and they ascribed the general calamity to the opening of the country to foreigners."

In 1877, information of the prevalence of cholera at some of the Chinese ports being forwarded by telegram from the Japanese consuls at Amoy and Shanghai, on the 26th of July efforts were at once made by the Central Sanitary Bureau, under the direction of Dr. Sensai, to prevent the ingress of the disease into Japan again, by the establishment of quarantine and quarantine hospitals at all the exposed Japanese ports. The foreign office of the government decided, however, that this was unnecessary; but in about ten days two cases of true Asiatic cholera occurred in the *ken* (city) of Kanagawa in the persons of two women employed in a tea factory. They were taken sick whilst working with tea, and it seems probable that they were infected from "merchandise which had come from Amoy and was kept in the godown of the firm."

The first case in Nagasaki Hospital was that of a boatman who carried goods from and to the foreign vessels in the harbour. Another focus of infection seems to have been a cemetery in which a sailor who had died of cholera on board of a British man-of-war in the harbor was buried.

"The epidemic of 1877," says Dr. Sensai, "was, I am glad to state, far less severe than any [either] of two plagues of 1822 and of 1858; but it remains still an open question whether the lives of the seven thousand eight hundred persons who died of cholera in 1877 might not have been saved if measures of medical inspection had been adopted at the open ports at the time of the receipt of the telegram from our consul at Amoy, when there had not yet been one case of cholera reported in our country."

The spread of cholera is traced from one city and prefecture to another with careful minuteness, but the disease appears to have been only moderately severe, and the cases infrequent until about 1st of October, when it became very violent among the soldiers returning from suppressing an insurrection in the province of Kagoshima. Six soldiers, for example, died upon the steamer "Wakanoura" on her way to Kobe; fifty were nearly dead on her arrival, sixteen died in the boats whilst they were going to land, and forty new cases broke out after the landing. Efforts were at once made by the Central Sanitary Bureau, to have the land travel of the returning soldiers stopped, and to secure the inspection and detention of diseased soldiers and others. These judicious precautions being inaugurated, the rapid extension of the disease was soon checked.

From Dr. Sensai's general conclusions we extract the following, which appear to be the most important:—

1st. The period of greatest prevalence was from October 1st to November 1st, 1877.

2d. Nagasaki, Kanagawa, Hiogo, Osaka, Kumamoto, and Kagoshima suffered most severely. In them the death-rate during the epidemic was from 10 to 61 for every ten thousand of the population and from 39 to 80 of every hundred persons attacked.

6th. A general diffusion of the disease over a population of 32,512,155 occurred without causing a great epidemic.

7th. The total number of persons attacked was 13,710, and that of those who died 7967, or 399 cases and 246 deaths for every 10,000 inhabitants. (This high death-rate of 58 per cent. is probably only apparent and due, we suppose, to failure to report many of the milder cases.)

8th. Nearly three times as many males as females were attacked.

Excellent official instructions in regard to the establishment and subse-

quent management of quarantine stations, cholera hospitals, etc., and a short but admirable paper on the use of disinfectants in cholera epidemics for purifying discharges from the sick, clothing and bedding, water-closets, hospitals, ships, etc., are appended to this report, which altogether forms a valuable addition to the literature of cholera as well as that of Hygienic science. J. G. R.

ART. XIX.—*De la Lésion des Organes Urinaires pendant l'Opération de l'Ovariotomie*, par M. le Docteur G. EUSTACHE, Professeur de Clinique chirurgicale à la Faculté libre de médicine de Lille, etc.

On Injury of the Urinary Organs during the Operation of Ovariotomy. By Dr. G. EUSTACHE. 8vo. pp. 32. Paris: J. B. Baillière and Son, 1880.

THE author divides the subject into three heads: wounds of the kidney, ureter, and bladder. *Wounds of the kidney* from its location are very rare, and but one case is cited, where, according to Mr. Spencer Wells, the kidney being strongly adherent to the tumour was removed with it, and the patient died. Cyst of the kidney has been three times mistaken for ovarian cyst, and the organ removed, after the disease was finally recognized. The cases quoted are those of the late Dr. E. R. Peaslee, of New York—woman died in 55 hours; of Dr. Meadows, of London—patient died of hemorrhage on the sixth day; and of Dr. Schetelig, whose patient having but the one kidney, died the day after its removal.

Lesions of the ureter are quite rare, and particularly so where the cyst is a true ovarian. Where the broad ligament is the seat of a parovarian cyst, the ureter is in greater danger. Prof. Eustache gives three cases of injury.

1. 1869. The late Dr. Simon, of Heidelberg, having accidentally cut the left ureter in an ovariotomy, removed the corresponding kidney, and the patient recovered.

2. Dr. Von Nussbaum, of Munich, in his ninety-sixth ovariotomy accidentally injured the right ureter, resulting in a urinary fistula. This he cured by ingeniously re-establishing the connection between the kidney and bladder.

3. Dr. Tauffer, of "Freibourg-en-Brisgau," met with the same accident in extirpating a parovarian cyst, and re-established the ureter in the way practised by Nussbaum.

Lesions of the bladder are much less rare; not that this viscus is in danger because of adhesions, for these seldom form, as it is external to the peritoneal cavity, and not inclined to become adherent to the cyst as an effect of inflammation. The situation of the bladder is its chief source of danger as it may be distended or elevated so as to be clamped or incised. It was wounded on one occasion by the author, which directed his attention to a line of research that has resulted in the production of the monograph under review. Ten cases are reported, the last being his own.

1. M. Péan, Paris. This was not properly a case in point, as the operation was a hysterectomy and not an ovariotomy.

2. Tauffer, of Fribourg, removed two ovarian cysts which were strongly adherent to the abdominal parietes and pelvic organs. On the eleventh day there were symptoms of suppuration, and pus escaped on the sixteenth

day by the abdominal wound. An attempt to drain this through the vagina by puncturing the anterior cul-de-sac, resulted in a wound of the bladder which closed in eight days.

3. Henry Smith, of King's College, reported a case in which the bladder was opened after the separation of pelvic adhesions in an ovariotomy: the woman died. He attributed the opening of the bladder to ulceration.

4. Spencer Wells once pinched the bladder in clamping a pedicle, and the urine subsequently escaped by the abdominal wound. The woman died; but this was attributed to other causes.

5. Knowsley Thornton met with the same experience in using the clamp, but it was fortunately removed and replaced before cutting the pedicle, and no sutures were required.

6. Granville Bantock reports a case where the ovarian cyst had formed extensive adhesions to the pelvic organs, abdominal parietes, and posterior surface of the bladder, even adhering to the symphysis pubis. The bladder was opened an inch and a half in making the separation; was sewed up, and the uterus secured against it, both surfaces having been torn in the operation. The patient did well for several days, and finally died of strangulation of the bowels by a false membrane.

7 and 8 by the same. In 7, the bladder was torn and immediately sutured, the case was otherwise desperate and died. In 8, the bladder was cut, it not having been well emptied, but not entirely through. It was at once sewed with fine carbolized silk, and the patient recovered without any vesical symptoms.

9. Spencer Wells in one case discovered urine escaping in the incision, and found an abnormally developed urachus extending to the umbilicus. He secured this in the abdominal sutures, and the patient recovered.

10. The author's case. Owing to extensive adhesions, and an abnormally elongated bladder, this viscus was opened at a point $4\frac{3}{4}$ inches above the symphysis, and $1\frac{1}{4}$ inches in length. Although much urine escaped into the abdominal cavity, its careful removal, suturing the bladder with catgut, and the continual use of the catheter caused the woman to make a good recovery. The catheter was worn five days, the patient was then directed to urinate every four hours. She was up in two weeks and out in a month.

Although a good English scholar, Dr. Eustache makes an error on page 8, in reference to Dr. W. H. Byford's second Cæsarean case, in these words, "having incised a gravid uterus during an operation of ovariotomy, and not being able to control the hemorrhage, decided at once to practise ablation of this organ." Dr. Byford punctured the uterus with a trocar, under the impression that it was a second cyst; and finding the young lady illegitimately pregnant, performed the ordinary Cæsarean section to save her life. Child $7\frac{1}{2}$ months, dead; woman recovered.

Dr. Eustache is the author of a number of monographs, and being a good linguist, is enabled to secure unpublished records by correspondence, thus adding much to their value. In the paper under review, several of the cases were thus obtained, and for this reason we have thought proper to reproduce them. Ovariotomies are so frequently performed, that it is remarkable, that so few instances of injury to the urinary organs are said to occur. It is evident that great caution is required, when such operators as Spencer Wells, Thornton, and Bantock have met with accidents in their cases.

R. P. H.

ART. XX.—*The Hypodermic Injection of Morphia. Its History, Advantages, and Dangers. Based on the Experience of* 360 *Physicians.* By H. H. KANE, M.D., New York. 12mo. pp. 354. New York: Charles L. Bermingham & Co., 1880.

WE well remember to have heard the late Dr. William W. Gerhard say in his clinical lectures at the Pennsylvania Hospital, that few physicians learned how to use opium until after they had killed two or three patients by it. This statement is, we are willing to believe, an exaggerated one; it served, however, to impress upon us, and doubtless upon other members of the class, the necessity for caution in prescribing this drug. This little book of Dr. Kane will also answer a good purpose by calling attention to the fact that the hypodermic administration of morphia is a procedure not entirely free from danger, and one, too, which is not to be resorted to in every case.

The author draws the material for his book, principally from the answers furnished by physicians both in this country and abroad, to a series of questions which he addressed to the profession, generally through the medical journals. These questions have reference chiefly to the dose employed, the supervention of inflammation or abscess at the point of puncture, the occurrence of death or other accident, and the contraction of the opium habit as a consequence of the administration of morphia hypodermically. It is rather amusing in reading the volume to note the various reasons given by different observers for the occurrence of abscess. Thus one physician attributes his immunity from this accident to the fact that he inserts the needle of his syringe deep into the muscles, while another asserts that this is the way most certain to bring it about. Others refer it, and with more reason, to a debilitated condition of the patient, or to the use of needles which have been allowed to become rusty, or foul from want of proper cleansing, rather than to any special method of making the injection.

Dr. Kane's correspondents give him the histories, in more or less detail, of 36 cases, in which death occurred after the use of morphia hypodermically, and was apparently attributable to it. He has heard also of several other cases of which he has not as yet been able to obtain the particulars from the gentlemen in whose practice they occurred. In a number of these the fatal result cannot be regarded as due in any sense to the operation, and in others it is, at least, doubtful if it were so produced. There remains, however, a sufficient number of cases to teach us caution in the use of the hypodermic syringe. In one case death followed the injection of one-eighth of a grain during an attack of *delirium tremens*, and in others fatal narcotism was produced by one-sixth of a grain. Other cases are adduced to show that intemperate persons bear morphia badly, and that the same is true of patients with contracted kidneys. Attention is also called to the necessity for care and circumspection in administering morphia hypodermically to patients, who have taken it within a short time by the mouth. In one or two cases which are referred to by the author, absorption by the stomach seemed to have been delayed until after the injection had begun to exert its influence.

The book is evidently the result of much labour, and its author deserves credit for the pains he has taken in collecting information on all points bearing upon the hypodermic administration of morphia. He is, however,

needlessly diffuse, and he has, perhaps, made a mistake in not adhering to his original intention of embodying the results of his investigations in two or three interesting journal articles. J. H. H.

ART. XXI.—*Skin Diseases, including their Definition, Symptoms, Diagnosis, Prognosis, Morbid Anatomy, and Treatment. A Manual for Students and Practitioners.* By MALCOLM MORRIS, joint Lecturer on Dermatology at St. Mary's Hospital Medical School, etc. With illustrations. 12mo. pp. 320. Philadelphia: Henry C. Lea, 1880.

THIS book was written, the author states, to supplement, not supplant, existing treatises, which should mean for the purpose of furnishing to the student and practitioner later information than other works at their command contain. It is perhaps true that the demand for such an undertaking existed among that part of the profession in Great Britain which is unacquainted with the foreign literature of the subject, but the recent publications of Neumann, Behrend, and Kaposi in Germany, and of Duhring in this country, left nothing untouched which this work supplies, and represent, indeed, a wider field of experience. The book, to be judged fairly, therefore, must be considered on its own absolute merits. It may be described as a very fair representation, on the whole, of the German school of dermatology, very brief in some parts, and more or less modified in others by the individual views of the author's English teacher, Mr. Hutchinson. As a manual of cutaneous therapeutics, it may at once be said, it is a failure. If the considerable space devoted to the chapters on the exanthemata, typhus and enteric fevers, diphtheria, equinia, etc., which are more fully treated of in all general and accessible works on medicine and surgery, had been used for such full and explicit directions for the treatment of skin diseases proper, as are alone of any value in the management of these affections, we could recommend the book more warmly to the practitioner. In some respects it is excellent, especially in the pathological anatomy of individual diseases.

The introductory chapter on anatomy and physiology, founded mainly on Biesiadecki's article in Stricker, is a simple and satisfactory sketch, well illustrated. It is a pity that the author felt the official necessity of inventing a new plan of classification. We cannot regard it as an improvement on the pre-existing work of the masters in dermatology, and it is strangely confused in some parts. For instance, syphilis is included among the exudations; herpes is an exudation, but zoster is a neurosis; many of the keratoses are classed as neoplasmata, not as hypertrophies.

It is not our purpose to criticize the author's views respecting the individual affections of the skin. They are treated of very unequally and in many instances far too briefly. His account of eczema, for example, is admirable in many respects, clear in description and diagnosis, but its treatment is disposed of in three pages. His management of psoriasis requires little more than a page, but in this space there is room for the following statement, which is at least misleading: "Though the employment of local treatment without any internal remedy does remove the external appearance of the disease, a real cure is not effected on account of its liability to return. Both modes of treatment should, therefore, be

adopted at the same time." This implies that internal treatment may effect "a real cure," or that it is more likely to do so than the external. We know of no data which warrant such an opinion. Again, the treatment of one of the most distressing and difficult affections to manage—pruritus—is presented in eleven lines. In conclusion we must express regret that a work which possesses many merits should fail in important respects of fulfilling the purpose for which it was undertaken. J. C. W.

ART. XXII.—*Thirteenth Annual Report of the Health Department to the Honourable Common Council of the City of Cincinnati, for the year ending December* 31, 1879. By THOS. C. MINOR, M.D., Health Officer. 8vo. pp. 311. Cincinnati, 1880.

THIS is a new departure in the form of Health Reports, and merits special attention from all who are interested in such documents, as well as from a large number who are not, but who ought to be. Dr. Minor has taken the schedules of questions issued by the National Board of Health for the purpose of indicating what is desirable in the sanitary survey of a city, embracing twenty-one different subjects, and, taking up each question seriatim, has briefly answered or discussed it, the whole making a connected report of a "Sanitary Survey of Cincinnati."

The result is a document which is a model of its kind, and which is not only of much interest and value at the present time, but will, for years to come, be referred to for information on the several subjects on which it treats.

It forms an interesting contrast to a book published sixty-five years ago which had the same general object. This work, which is now rare, is the "Natural and Statistical View or Picture of Cincinnati and the Miami Country," by Dr. Daniel Drake, published at Cincinnati in 1815, which, as the author says, is "an account of a village in the woods." Dr. Drake had to consider the sanitary relations of a town of 1100 houses, containing about 6000 inhabitants. Dr. Minor deals with a city having about 45,600 houses, and a population of nearly 300,000. The system of hauling water from the river in barrels, and allowing it to settle, described by Dr. Drake, has given place to elaborate water-works, with an average supply of 17,000,000 gallons per day, and the open ditches of old time are now large and expensive sewers.

This change is not, however, an unmixed good. The outlet for the whole sewer system is the river in front of the city, but this system has only been adopted within the last five or six years, and a large part of the city lies above the water-works. From the description it is clear that the water-supply is becoming more and more contaminated with the excreta of this part of the city, which has no sewers; but Dr. Minor's somewhat cynical remark is no doubt correct, viz.: "Owing to the lack of public interest in the matter, no steps will probably be taken to obviate the growing evil until an epidemic visitation, directly traceable to a contaminated water, shall occur, and a few hundred lives be sacrificed."

In connection with this part of the subject a reprint is given of a rare document of much interest, being the report on the Ohio River water, made for the City Water-Works in 1856, by Prof. Locke.

Space is wanting for anything like an analysis of the Sanitary Survey, and this is the less desirable since the information is already stated as briefly as is consistent with clearness.

Every municipal health officer should obtain a copy, and "go and do likewise." Especially should this be the case for those towns which are just beginning to pay attention to sanitary matters. The time is not far distant when every city in this country will feel the need of some such record as this. No doubt it might be improved; the preparation of such a document is a capital means of finding out what one does not know; but the first step towards supplying deficiencies is to discover them.

From such an "account of stock" as a starting-point, it will be easy to keep the sanitary books well posted up, and to mark the progress which will be made. The publication of such a document as this is also one of the best means of educating the community as to the necessity which exists for guarding against those special causes of disease due to the collection of large numbers of men on limited areas.

The possibilities of public hygiene depend on such education, and to promote it should be one of the main objects of health authorities, whether municipal, state, or national; for without it they have no firm foundation in a country having either a republican or a democratic organization.

J. S. B.

ART. XXIII.—*Montreal General Hospital. Reports, Clinical and Pathological, by the Medical Staff.* Edited by WILLIAM OSLER, M.D., M.R.C.P. Lond. Vol. i. pp. xxii., 367. Montreal: Dawson Bros., 1880.

THERE are two large hospitals in Montreal—the General Hospital and the Hotel Dieu. The former derives its patients chiefly from the English-speaking portion of the community, and has 170 beds, but during the last two years the income of the hospital has been insufficient to keep more than 140 of them constantly occupied. Still the opportunities for observation afforded by it must be more than fair, since 1600 patients are annually treated in its wards and 15,000 at its dispensaries. It enjoys, moreover, the enviable distinction of being the first institution in Canada to publish a volume of Reports. The volume has, moreover, claims of its own upon the favour of the profession in the general excellence of the papers contributed by the members of the medical staff, who, we hope, may meet with sufficient encouragement to justify them in issuing, as they propose, other volumes from time to time. The medical papers are more numerous than the surgical. We shall call attention to them first.

Dr. R. P. HOWARD, who reports four *Cases of Leucocythæmia*, is already well known to American readers through his paper on Pernicious Anæmia, published in the "Transactions of the International Medical Congress," held in Philadelphia in 1876. In three of his cases the patients were males and were under sixteen years of age. Indeed one of them was an infant of only eight months when it came under observation. A post-mortem examination was made in two of the cases, one of them being that of the infant already referred to. Particular attention was paid to the examination of the marrow of the bones, which was found to present in a high degree the changes which have been of late attributed

to a hyperplasia of this structure. The author is, however, disposed to regard these changes as the consequences rather than as the causes of the disease, and for the following reasons: 1st. He is not aware that an unexceptionable instance of primary myelogenous leucocythæmia is on record. 2d. These changes are never met with in an early stage of the disease. 3d. They are present in various other conditions, as for instance in Hodgkin's disease, or pseudo-leucocythæmia, in pernicious anæmia, in Addison's disease, and in chronic diseases attended by marasmus, as, for example, phthisis. They have also been met with in tubercular peritonitis, and in osteo-myelitis experimentally produced in animals. He also agrees with those who deny that the medulla of the bones is concerned in the development of the white corpuscles of the blood, and maintains with Dr. Moxon and Dr. Schtschastny, of St. Petersburg, that the lymphoid cells found in the bone-marrow in leucocythæmia are leucocytes which have escaped from the bloodvessels.

Nucleated red corpuscles were found in the blood of all the patients. This would appear to be exceptional, as Mosler has never seen them in leukhæmic blood. In none of the cases, however, were they present in large numbers; indeed, in one of them a single one only was found after prolonged examination. On the other hand, no microcytes were detected, although they have been occasionally met with in this disease by other observers.

The *Medical Cases* reported by Dr. GEORGE ROSS are, 1st. *Case of Extreme Dilatation of the Stomach.* 2d. *Case of Cirrhosis of the Liver, with great Enlargement.* 3d. *A Case of Athetosis, or Unilateral Slowly-moving Spasm.* 4th. *A Case of Acute Spinal Paralysis in an Adult (Poliomyelitis Anterior Acuta).* The patient in the first case was a woman aged 37 years, who up to five months before her death considered herself in perfect health. At that time she began to suffer from dyspeptic symptoms, especially from a squeezing sensation at the pit of the stomach. Later nausea and vomiting, with a "burning" in the stomach, occurred. When she came under observation the stomach was found to be enormously dilated. When deep pressure was made below and to the right of the umbilicus, a small, rather firm, and somewhat irregular lump, apparently occupying the seat of the pylorus, could be made out. After death the stomach was removed from the body and found to measure 45 cm. in length, 19 cm. in breadth at the middle, and 21 cm. in breadth in the pyloric region. Its capacity, measured with water, was about eight pints. A semicircular ulcer, 4.5 cm. in length, 2 cm. in breadth, and situated close to the pylorus, had puckered the mucous membrane in such a manner that several folds appeared completely to close the orifice. Nothing in the patient's history indicated that she had ever been the subject of gastric ulcer, although she was of course closely questioned with special reference to this point. It was thought that the stomach pump was of use in this case by relieving the sense of distension, which was a distressing symptom.

In the second case the patient was a young woman of intemperate habits, who, after presenting the symptoms of a slight attack of jaundice for a few weeks, began to vomit blood, as much as a large bowlful of black clotted blood being thrown up at one time. This symptom was succeeded by more intense jaundice, chills, pain in the abdomen, principally in the epigastric region, bloody stools, thirst, and fever. Upon examination the liver was found to extend down to the anterior iliac spine, and to be ten-

der upon pressure. The urine contained albumen. The autopsy confirmed the diagnosis which had been made during life. In cirrhosis with enlargement the symptoms differ, Dr. Ross says, from those observed in the more ordinary form of the disease. The former pursues a more rapid course, and is more usually accompanied by jaundice than the latter. On the other hand, it is rarely complicated by ascites.

The third case is one of great interest. Its principal points are as follows: A lad aged 20 years, who had always been lame in his right leg, and weak in his right arm, both of which were smaller than their fellows, received, through the accidental explosion of a revolver, a bullet wound in the sixth interspace of the left side, beyond the nipple, which was followed by empyema. This was successfully treated by a free incision and subsequently by disinfecting injections. Ten days after the accident, however, while he was suffering a good deal from his side, his right arm and leg were suddenly seized with active continuous spasmodic movements. These movements continued for some time, and were so violent that his friends became alarmed and endeavoured to restrain the limbs by fastening them with bands to the bed. He never lost consciousness, and never had a convulsion. This condition of clonic spasm gradually wore off, and was succeeded by peculiar motions of the fingers and toes, which we will let Dr. Ross describe in his own words: "The spontaneous movements, when watched," he says, "appear to consist of a series of muscular contractions, beginning in the extensors of the phalanges and passing thence up the arm, along the muscles of the anterior region, flexing the wrist and forearm, and rotating the hand from within outwards. At the same time there is a movement of abduction in the phalanges, all the other fingers being drawn away from the middle finger. The muscles of the arm and forearm can be felt to contract, especially the biceps; the muscles of the shoulder and the pectoralis major also participate." He had very little voluntary control over the muscles moving the fingers and hand. Involuntary spasmodic contractions were observed to occur at short intervals in nearly all the muscles of the right lower extremity, but were not so strong or so marked as in the arm. Sensation was unaffected.

These nervous symptoms seemed to be unaffected by remedies, and were present when the patient was discharged from the hospital. Rather curiously the movements ceased while the patient was under the influence of ether, which was given to him for the performance of the operation above alluded to, and did not return when he regained consciousness, but gradually reappeared at the end of a week.

If our memory serves us, in the condition described by Dr. Hammond, the involuntary movements are confined to the fingers. In this case it will be noticed there were spasmodic contractions of the muscles of the arm and thigh. It would seem, therefore, more proper to regard it as an example of post-paralytic chorea—a condition which has been recently described in this Journal by Dr. Weir Mitchell and others.

The case of poliomyelitis presented some unusual symptoms, viz., convulsions, hyperæsthesia, pain, and increase in the reflex movements. Its general features were, however, certainly those of the disease described by Althaus under that name, and the author explains the unusual symptoms by supposing that other parts of the gray matter of the cord than the anterior cornua had become involved in the morbid process.

Dr. George Wilkins is the author of two papers. In the first he reports a *Case of Spinal Apoplexy*, the subject of which was a married

man, 40 years old, who for about a week before the occurrence of the hemorrhage had suffered from some vague symptoms of disease of the cord, such as flushes of heat, chills, slight pains in the limbs, and a feeling of not being quite so well able to work as usual. On the day previous to his admission to the hospital he took four or five glasses of spirits and lay down on the floor of the room, where he fell asleep. On awakening and attempting to rise, after lying there five or six hours, he found he was completely paralyzed. When first seen by Dr. Wilkins, there was complete loss of power and sensation in the body and limbs below the line of the nipples; also loss of muscular power in the arms, except in the flexors of the arms, and loss of sensation except over the radial side of forearm, in which region, although able to recognize a piece of money, he cannot differentiate heat and cold. There was also complete absence of reflex excitability in the paralyzed parts, and almost complete absence of faradic irritability on applying a current to the legs. His temperature on admission was 103.2°. It rose on the following morning to 104.3°, falling the same night to 99.2°, and the next morning to 96°, at which it remained, with a variation of 0.2° on one day, up to the time of his death. This occurred on the tenth day, and was due to asphyxia, caused by an accumulation of mucus in the bronchial tubes, which he had not the power to expectorate.

At the post-mortem examination a clot was found in the spinal cord extending downwards from the point of origin of the second cervical nerve to that of the fourth dorsal. That portion of it between the fifth and eighth cervical nerves was somewhat cone-shaped, the larger extremity of the cone being opposite the origin of the fifth cervical nerve, where it was twelve by five millimetres in diameter, dwindling down to about two millimetres in diameter, opposite the eighth cervical nerve, below which it was continued as a mere trace to the lower limit first mentioned; opposite the lower fibres of origin of the fifth cervical it became suddenly smaller, after which it gradually diminished in size to the upper limit first mentioned. The clot occupied the centre of the cord, and where small enough appeared to the naked eye to be limited to the gray matter.

On microscopical examination the cord was found to be more vascular than normal, many of its vessels had aneurismal dilatations, and several of the sections showed capillary extravasations. Other changes of an inflammatory nature were also found and served to explain the nervous symptoms which preceded the graver ones due to the apoplexy.

The second communication from Dr. Wilkins is a full description, accompanied by two plates, of *a new kymograph*, an apparatus which is intended to facilitate the demonstration of physiological experiments to a class of students.

Dr. WILLIAM OSLER contributes two pathological papers to the volume. The first of these is entitled *Cases of Cardiac Abnormalities*, and contains the records of four autopsies with remarks. The first case reported is one of general dropsy of the fœtus depending, in the author's opinion, upon premature closure of a foramen ovale. He admits, however, that general dropsy has existed in fœtuses in which the foramen ovale has been found perfectly healthy. Indeed, in some of the reported cases the heart is said to have been entirely healthy.

The interest in the second case attaches to the fact that the subject of it lived for four months, although an extreme degree of stenosis of the pulmonary orifice was present, and was unaccompanied by imperfection of the ventricular septum or patency of the foramen ovale, a condition in which

Rokitansky has never known life to be prolonged for more than three months. In the third case there were atresia of the pulmonary orifice, hypertrophy of the left ventricle, imperfection of the septum ventriculorum and patent ductus arteriosus. In the fourth case the descending aorta with the left subclavian artery was given off from the right ventricle while the innominate and left carotid arteries came off from the left ventricle.

Dr. Osler's second paper is *On the Condition of Fusion of Two Segments of the Semilunar Valves.* In it he reports seven cases in all of this curious condition, which he is inclined to attribute to primary malformation rather than to the effects of inflammation.

The patient in Dr. JOHN REDDY'S *Case of Rupture of Mitral Valve* had been for some time a sufferer from disease of the heart. While engaged in dumping his cart after a day of unusually hard work, he was suddenly attacked with pain in his left side and "felt that he could not work much longer." He, however, continued to work until evening, and although he suffered severely the next day from cough and dyspnœa did not apply for admission to the hospital until four days after the accident. On admission, a double murmur was heard all over the chest, but loudest at the base of the heart. The systolic murmur was so loud and harsh that the diastolic seemed feeble by contrast, and the breath sounds were obscured by it. At the autopsy, the aortic segment of the mitral valve was found floating loosely in the cavity of the ventricle, its chordæ tendineæ having been ruptured.

Dr. T. G. RODDICK communicates the history of a *Remarkable Case of Favus* in which the eruption besides covering almost the entire scalp was well marked and extensive on the back of the neck, along the spine of the scapula, and on the outer side of the arm as far as the junction of the upper with the middle third of the forearm, being especially thick over the point of the olecranon. The sides of the body and buttocks were thickly covered, and the crusts here were remarkably well-defined, being rounded, and in places standing isolated from one another. The patches on the limbs were also most characteristic, and were confined almost exclusively to the extensor surface. The patient was a girl ten years old, several of whose family had suffered from the same disease. Recovery eventually took place under the use of the usual remedies, viz. epilation and the sulphurous acid lotion. The paper is accompanied by a plate showing the distribution of the crusts and the extent of the eruption on the body.

The *Pathological Report*, by Dr. WILLIAM OSLER, comprises the reports of 42 post-mortem examinations, which have been selected on account of their interest from the 225 autopsies made at the hospital between October, 1877, and October, 1879. It includes several very unusual cases, as for instance nine cases of aneurism, there being no less than four cases of intracranial aneurism among them, and it has evidently been prepared with great care.

The last paper in the volume is a *Statistical Review of Cases of Typhoid Fever, Pneumonia, and Acute Rheumatism treated in the Hospital during the Ten Years ending May* 1, 1879, *with Remarks thereon*, by Dr. JAMES BELL, House Surgeon. From this we learn that during this period there were treated at the hospital 660 cases of typhoid fever, with a mortality of 10.45 per cent.; 353 cases of pneumonia, with a mortality of 25.8 per cent.; and 456 cases of acute rheumatism, with a mortality of 1.75 per cent. The mortality of all these diseases, however, varied at different seasons and in different years. This paper is provided with six tables, the

first three of which are arranged to show the number of cases of each disease treated and their termination in each month. The last three are arranged to show the influence of sex and age, and they also give the yearly mortality percentum. J. H. H.

The surgical papers in this volume will require but short notice, since they number only seven, and are mostly made up of records of isolated cases. Two of them are on ophthalmic subjects, one, comprising a list of anomalies found in the dissecting room of McGill University, is written by an out-door surgeon, and the four remaining papers are the work of Dr. T. G. Roddick. It will thus be seen that the wards of the hospital have furnished but little on general surgery, and this has all been contributed by one attending surgeon. The other members of the staff must be considered mere figure heads as far as literary contributions from the hospital are concerned.

The article on *Anatomical Abnormalities*, by FRANCIS J. SHEPHERD, M.D., is of much interest, and is illustrated by a number of excellent lithographs. Some of the anomalies mentioned are rare, though Dr. Shepherd has evidently not failed to record the anomalies that occur frequently. It is important to note that in twenty-eight cases where the obturator artery arose from the epigastric, in only two did it pass along the inside of the femoral ring.

In the report of *Fifteen Cases of Tumour of the Breast*, Dr. RODDICK claims that the good results after excision were due to the antiseptic method. He makes further reference to this method of treatment in *Remarks on Lister's Antiseptic Method as practised in the Hospital;* in which paper he gives a table showing the death rate to be 3.12 per cent., and states that previously the occurrence of erysipelas and blood poisoning after operations were very frequent.

In an article entitled *Surgical Records* a number of clinical cases are detailed by the same gentleman. An instance of caries of the atlas and axis, with retro-pharyngeal abscess, is mentioned, in which recurring paralysis took place on motion of the patient. This was shown by the autopsy to be due to displacement of the odontoid process, which had lost its ligamentous attachments. A successful case of excision of the lower end of the rectum, and an instance of traumatic tetanus which recovered under the use of chloral, are recorded.

In a fourth paper he furnishes an account of a child suffering with *occipital meningocele*, which he treated by a seton on account of the urgent solicitation of the parents. Death, however, occurred in two weeks.

The two ophthalmic papers are by Dr. FRANK BULLER, and are entitled, *On the Use of Eserine in Ophthalmic Practice*, and *Miscellaneous Ophthalmic Cases*. He has seen some benefit from eserine in certain cases of glaucoma, but says that in corneal ulcer he has observed circumorbital pain and synechiæ occur. An interesting case of syphilitic condyloma of the eyelid, with bubonic enlargement of the lymphatic glands over the parotid, is worthy of the attention of those interested in ophthalmology.

J. B. R.

ART. XXIV.—*The Essentials of Anatomy, designed as a Text-book for Students, and as a book of easy reference for the Practitioner.* By WILLIAM DARLING, M.D., F.R.C.S., Prof. of Anatomy in New York University, and A. L. RANNEY, M.D., Adjunct Prof. of Anatomy in New York University. 8vo. pp. xvi., 629. New York: G. P. Putnam's Sons, 1880.

THE title of this book exactly represents its purpose. It is not a treatise on anatomy, nor is it a descriptive, topographical, or surgical anatomy. Accordingly it has no accurate and full descriptive text, and no illustrations (though it has a few diagrams); but it is a grouping of the prominent and *essential* facts of anatomy briefly and clearly stated. To use it alone, without either such a book as Quain or Gray or Henle, and a manual of dissections like Heath's, would be a grave error, but with them it will prove an exceedingly valuable book. Its chief merits, in fact its distinguishing features, are its mechanical arrangement, and particularly its numerous and systematic tabulations which recur on almost every other page. The value of these in assisting us to recall our anatomy, every one will readily recognize. Especially is this true of those relating to the arteries and nerves.

For the very reason that the book is good, we point out a few minor errors that should be corrected in any subsequent edition. Thus on page 7, the bones of the leg are stated as the patella, tibia, and fibula, but are added up as only two; and on the same page it is stated that the sesamoid bones are excluded from the enumeration, yet the patella has just been included.

In the table opposite page 76, the *foramen lacerum orbitale* should be "*anterius*" to correspond both with custom and the foramina "*medium*" and "*posterius*" of the same table. On page 92 the minor centres of ossification are called "complimentary" instead of complementary. The Y ligament of the hip should be designated as the inverted Y ligament on pages 187–9. More serious errors are the non-recognition of the proper muscular actions of the supinator longus as a flexor, its chief function, and of the interossei in flexing the first and extending the last two phalanges. Again the whole length of the urethra is stated at $8\frac{1}{2}$ inches of which $1\frac{1}{4}$ are prostatic and 6 spongy. The length of the membranous portion is not given, but must be erroneously inferred as $1\frac{1}{4}$ inches. On page 296 the height is stated as equal to the distance between the tips of the middle fingers when the arms are extended horizontally. From say three to five years of age this is true, but at birth the male height exceeds the finger tip measure in the proportion of 1000 to 987, while in the male adult it falls considerably below it in the proportion of 1000 to 1046. At both ages the measurements are much more nearly identical in the female (1000 : 993 and 1000 : 1016). W. W. K.

ART. XXV.—*The Influence of School Life upon the Eyesight, with Special Reference to the Public Schools of Dayton.* By W. J. CONKLIN, M.D., Prof. of Diseases of Children in Starling Medical College, Dayton, Ohio, 1880. Pamphlet, pp. 32. Dayton, 1880.

THIS little pamphlet of 32 pages is a very praiseworthy effort towards practically applying the facts and suggestions which we owe to Cohn,

Liebreich, and their followers, and which were presented to the readers of this Journal in an article on the Hygiene of Sight, in July of last year (p. 220). Prof. Conklin's essay was adopted by the special committee appointed to consider the subject, and was submitted to the Board of Education March 12, 1880, and printed by order of the Board. Being intended especially for the non-medical public, Dr. Conklin judiciously prefaces his observations with a short description of the usual forms of divergence from normal vision met with in scholars, and then furnishes in tabular form the results of his investigations into the condition of the pupils in the Dayton schools. The tables show that out of 333 pupils in the District (or Primary) Schools, 48, or 15.35 per cent., were myopic; out of 153 in the Intermediate Schools, 27, or 17.65 per cent.; and out of 279 in the High School, 18.32 per cent. were affected with myopia. Dr. Conklin appears to have made an error in his calculation of the percentage of myopes in the District Schools, which should be given at 14.41, instead of 15.35, a number so unusually large that he attempts on page 10 to explain away some of its exaggerated magnitude. Very truly and very much to the point does he remark on the next page, "Statistics are often like a two-edged sword, the unskilful wielding of which may injure friends as well as foes, but there does not seem to be any escape from the conclusion: First, that the percentage of short-sightedness increases as a rule proportionately with the advancement in the school grades. Second, that Dayton schools offer no exception to the rule."

The author then proceeds to review in detail the heating, ventilating, and mode of illuminating of the various school-houses, pointing out in accordance with sound and correct principles the errors and deficiencies with which the educational edifices of Dayton, like too many at home and elsewhere abroad, are afflicted. In regard to school furniture, Prof. Conklin arrives at almost the identical conclusions reached by Liebreich, in his lectures already referred to. Some excellent rules respecting the use of the eyes, ordered to be printed in large type and placed in every school room, are appended to the report. J. G. R.

ART. XXVI.—*Narrowing, Occlusion, and Dilatation of Lymph Channels; acquired forms.* By SAMUEL C. BUSEY, M.D. Reprinted from N. O. Med. and Surg. Jour., 1876–1878. 8vo. pp. 195.

THIS work and one previously reviewed (see this Journal for October, 1878, p. 527) are complementary to each other, the one dealing with congenital, the other with acquired forms of the same diseases. Like the former volume, this consists largely of cases (67 in number), which are given in a *résumé* or in full according to their importance, and discussed with all the fairness and also the faults to which we previously called attention. But for any one who wishes to study the subject, we do not know any compendium of facts and cases at all to be compared with these two volumes, and they represent an amount of labour and research that few can understand who have not done similar work. The account of the anatomy of the lymphatic system is very good, yet we must confess to some surprise at seeing Gray quoted in the bibliography, while Sappey and Cruveilhier are omitted. The fact of its being a republication from

time to time from a medical journal, is responsible, we presume, for its poor typographical appearance, but that cannot excuse the absence of any index, without which no scientific book should ever be published.

W. W. K.

ART. XXVII.—*Post-Mortem Examinations, with especial Reference to Medico-Legal Practice.* By Professor RUDOLPH VIRCHOW, of the Berlin Charité Hospital. *Translated from the Second German Edition*, by Dr. T. P. SMITH. 8vo. pp. 145. Philadelphia: Presley Blakiston, 1880.

IN the publication of a translation of the enlarged reprint of Virchow's contributions to the first volume of the "New Annals of the Charité Hospital," an exceedingly practical and handy work is offered to a large circle of readers.

We are informed in precise and exact terms how a post-mortem examination should be made, both with regard to the plan to be pursued, and the manner of making the several cuts into the various organs and tissues. The method of recording the results of the investigation is clearly indicated by the addition of the detailed account of the examination of four cases, and the value of the objective evidence is accurately stated in the form of the inferences which are drawn concerning the manner and cause of death.

The addition of the Regulations of the Prussian Government for the guidance of its medical officers is of especial value to those who may be employed to make autopsies for medico-legal purposes. It is earnestly to be desired that a copy of these regulations should be in the hands of every coroner and medical examiner in the country, and that his report to the grand jury or magistrate should be based upon the plan here presented. The opinions of medical experts would carry far greater weight and be much less liable to rebuttal if the data thus collected were placed before them in so accurate and unprejudiced a manner as the close following of these regulations would necessitate.

R. H. F.

ART. XXVIII.—*Transactions of State Medical Societies.*

1. *Proceedings of the Louisiana State Medical Association at its Second Meeting, held in the City of New Orleans, April* 9, 10, and 11, 1879. 8vo. pp. 206. New Orleans, 1879.
2. *Transactions of the Thirty-fourth Annual Meeting of the Ohio State Medical Society, held at Dayton, June* 3, 4, and 5, 1879. 8vo. pp. 218. Columbus, 1879.
3. *Transactions of the Indiana State Medical Society*, 1879. *Twenty-ninth Annual Session.* 8vo. pp. 252. Indianapolis, 1879.
4. *Transactions of the Twenty-ninth Annual Meeting of the Illinois State Medical Society, held at Lincoln, May* 20 and 21, 1879. 8vo. pp. 302. Chicago, 1879.

1. THIS volume of the *Louisiana Proceedings* contains two principal articles: Dr. Chaillé contributes an address on State Medicine and Medical

Organization, which briefly considers some of the more urgent questions usually discussed under the different branches of the subject. State medicine, he defines as "the application by the State of medical knowledge to the common weal, and embraces every subject for the comprehension of which medical knowledge, and for the execution of which the legislative and executive authority of the government, are indispensable."

Dr. Joseph Jones, in an article of one hundred and twelve pages, has furnished an exhaustive review of the "Comparative Pathology of Malarial and Yellow Fevers," which is largely historical and descriptive, but concludes with a summary of the clinical features of these two diseases arranged in parallel columns in order to bring out the contrast for diagnostic purposes. A critical study of yellow fever, *upon the spot*, by Prof. Jones, leads him to draw the following practical conclusions:—

"1st. The increase in the number and extent of the epidemics of yellow fever in New Orleans has been intimately associated with the accumulation of unacclimated human beings in the city, and with the increase of commerce and the consequent crowding and the accumulation of filth and crowd-poison in ships, and in badly constructed, and badly drained and policed habitations.

"2d. By its geographical position, by its peculiar topography, situated upon a low, alluvial, badly drained, swampy plain, surrounded by large bodies of water; by the exposure of an extended river bank, putrid, stagnant canals and marshes; by defective drainage, sewage, and police; and by its hot and moist climate, New Orleans has been peculiarly exposed to the ravages of yellow fever.

"3d. No such marked differences exist between the climate of New Orleans and that of Havana and Vera Cruz as would warrant the assertion that yellow fever is always endemic in the latter two cities and that at the same time it cannot originate *de novo* in the former. Whilst it is the wish of every true patriot to claim all excellences of position and health for the land of his choice and love, at the same time the future advancement of sanitary science and the highest interest of humanity demand that all causes of disease, whether existing in the soil or climate, should be honestly stated and fully weighed. In sanitary science, as well as in disease, and the science of medicine, the proper remedies and preventives can only be fully appreciated by a comprehension of all the dangers and difficulties.

"4th. Those who hold to the view that yellow fever never originates in New Orleans, but is *always imported*, must at least be forced, by the past history of the great epidemics of this city, to admit that its climate and situation are such as to admit of the easy lodgment and rapid propagation of the seeds of this disease.

"5th. Every system which would look exclusively to the defence of New Orleans from pestilence by quarantine is vicious, and destructive at once to commerce and the best interest of the city, in that it leads to the neglect of those sanitary measures which will best promote the removal and eradication of the causes of disease, and the removal of those physical conditions which promote the rapid spread of destructive epidemics.

"6th. It may be possible to institute at once a just and enlightened system of quarantine and hygienic rules among the agents and in the vehicles of commerce, and an enlarged and progressive system of sanitation, embracing thorough drainage, abundant water supply, rapid and efficient removal of all excrementitious matter, and the proper elevation and construction of well-ventilated and thoroughly policed houses."

The President's annual address was presented this year by the senior Vice-president, Dr. Bemiss, who also refers to the important subject of yellow fever and its prevention by sanitary measures and quarantine; and speaks in high terms of the National Board of Health and of the importance of the labour in which it is engaged.

Among the short papers in this volume is one by L. F. Salomon, M.D., presented as a report on the Existence of Leprosy in Louisiana. Notes of fourteen cases were communicated, six of which were in New Orleans. The writer recommended the isolation of lepers, as the disease may spread in three ways: by heredity, inoculation, and possibly by too free communication of the healthy with the sick. A more complete report upon this very important subject was promised for the next meeting.

A very interesting case of amputation of a toe of a coloured man while under the influence of mesmerism (artificial hypnotism of Carpenter) was contributed by Dr. E. S. Day, of Hempstead, Texas.

Dr. M. Schuppert, in discussing "The Cure of Oblique Fracture of the Thigh Bone without Shortening of the Limb," repeats the old claim, that has been repeatedly proved to be erroneous, that the application of the plaster of Paris bandage will prevent any shortening after the oblique fracture.

2. The retiring President of the *Ohio State Medical Society*, Dr. B. B. Leonard, selected as the theme for his address one of the great questions of the day, "State Government and Medical Organization," which forms an admirable supplement to Dr. Chaillé's address, before referred to, and which similarly urges a higher appreciation of the services of the skilled physician to society, and skilfully suggests some of the steps to a higher position.

Prof. Roberts Bartholow, now of Philadelphia, contributed a very practical and valuable paper "On the Treatment of the various Forms of Consumption" in which a routine treatment is strongly condemned, for which he would substitute one adapted to the form of the disease; caseous pneumonia, chronic tuberculosis with localization in the pulmonary parenchyma, and so-called fibroid phthisis, forming the three principal varieties.

A climate possessing purity, dryness, and elevation, and uniform as to moisture and temperature, is the best for consumptives, while the proper care must be paid to their hygiene and nutrition. The condition of the digestive organs should be considered of primary importance, and gastric catarrh be relieved by appropriate means; at the head of the remedies for this condition he would place arsenic, and next to it silver, either as oxide or nitrate. Pepsin and cod-liver oil can be taken with advantage; if there be vomiting, strychnia is very efficient. Alcohol, after meals, is often of service, the usual amount being about half an ounce. In caseous pneumonia, the salts of ammonia increase the alkalinity of the blood, prevent the coagulation of fibrine, and possess a solvent power over exudations. Preferably, the carbonate is exhibited, dissolved in the solution of the acetate, and if the iodide be given conjointly, they should be made into an emulsion.

Rest, in the treatment of phthisis, is of paramount importance, when fever is present. For the relief of cough with profuse expectoration, carbolic acid may be given; but when the cough is severe, with reflex vomiting and night-sweats, the author orders a combination of codeia, or morphia sulphate, atropia sulphate, and strychnia sulphate. The atropia is of marked efficacy in consumption, and may be taken in small doses for years without disadvantage, according to Dr. Bartholow.

The "Preservation of Good Eye Sight, and the Use of Spectacles," by J. H. Buckner, M.D., contains practical information upon eye troubles, especially the causes of the prevailing errors of refraction, that every

physician should be acquainted with. The London smoke glasses are better suited to weak or sore eyes than either green or blue, since they do not change the light, but simply soften all the rays.

A report from the Special Committee on the Progress of Surgery, by S. F. Forbes, embodied short references to some of the principal improvements suggested during the preceding year. Dr. D. N. Kinsman also presented a very instructive report on Hog Cholera.

Dr. J. C. Reeve, of Dayton, read a paper, urging the practice of Mixed Anæsthesia, *i. e.*, preceding by a small dose of morphia the administration of the anæsthetic, which he believed lessened the danger of the inhalation.

A short article by Dr. P. S. Conner, recommends the use of the plaster of Paris roller in the treatment of club-foot, on account of its cheapness, comfort, and efficiency.

In an article upon Sanitary Laws, Dr. Geo. E. Walton presents a very timely and suggestive essay upon the important question of How Far a Government should Interfere with Private Right for Public Benefit. In its application to medical practice he considers that, in the words of Baron Humboldt, "it is not only advisable, but necessary, that the State should examine into the qualifications of those who destine themselves for such pursuits, provided they agree to submit themselves to its tests, and furnishing them with testimonials of fitness, in case of a favourable issue of the inquiry, to acquaint the citizens they can only confide with certainty in those who have thus been proved."

Short papers upon Glaucoma, by Dr. S. C. Ayres, referring particularly to temporary dimness of vision and headaches, the immobility of the pupil and episcleral injection, that indicate to the watchful observer the first insidious approach of this unfortunate malady; and calling attention to the use of duboisia and iridectomy in the treatment, has considerable practical interest. The Metric System is the subject of a communication by J. F. Baldwin, M.D., and after a calm and critical consideration of the question, in which its objections are fairly stated (and after two years' personal experience in its use), he concludes that "the metric system possesses no advantage over our old method of writing prescriptions (save the scarcely tangible one of uniformity with Europe), while it does possess several manifest and even obtrusive disadvantages."

The papers contained in this volume are short and practical, brief, and to the point. Other State societies would do well to adopt the same rule, limiting the length of addresses and essays.

3. The *Indiana State Medical Society's Report* is in a neat octavo volume bound in cloth, and contains, what the preceding two lack, a table of contents. Eleven practical and generally brief papers are presented, besides the minutes, etc. The President's annual address, delivered by Ben. Newland, M.D., is upon almost the identical topic of the two volumes we have just noticed. "The Relations of Legislation to Sanitary Protection." In pointing out some of the needs of the people, the position of the physician in the community is defined, and the right of the people to be protected from ignorant and criminal practitioners of medicine, and particularly the advertising charlatan, is insisted upon. The following very pertinent reference and proper recommendation is made in regard to proprietary medicines.

"The last legislature saw fit to make rules in regard to a statement of the ingredients of fertilizers being labelled on every barrel of the article sold within

the limits of the State. It also prescribed by statute the test to which coal oils should be subjected before they should be permitted to be sold. Would it be asking too much, that these provisions should be extended by law to all patent medicines sold to the people, in order that they might be able to know what ingredients they were to consume in these so-called medicines, and also might be protected from extortion, and not forced to pay a dollar or more for a little water, molasses, essence of wintergreen, and tincture of wild-cherry bark, and done up with a fancy label bearing the captivating text, 'Dr. Cureall's infallible, sure cure for consumption and all kindred complaints, including scrofula and diseases of the kidneys.'"

The address closes with a strong appeal for the establishment of a State board of health, and the passage of a law for the regulation of medical practice.

In a paper entitled the "Rational Treatment of Dysentery," Dr. George L. Andrew advocates the view of the specific nature of the disease, and its treatment by ipecacuanha and salicylate of sodium. Ergot, on theoretical grounds, is also recommended.

Dr. Enoch W. King presents statistics of placenta prævia, and by direction of the Society continued his observations to report at the succeeding meeting. Dr. E. S. Elder advocates Crede's method of delivering the placenta, and prefers deferring the ligature until after placental delivery.

"Excision of the Knee-joint, with Cases," is the title of a communication from Dr. Joseph Eastman, in which amputation for chronic synovitis is condemned, and excision of the joint recommended in preference. Dr. R. E. Haughton contributes a report of "A Case of Fracture of the Cervical Spine" (fatal), and urges operative interference in cases of fracture of the vertebræ, with pressure on the cord.

4. In the annual address of the President of the *Illinois Society* Dr. E. P. Cook gives due attention to sanitary legislation and the regulation of medical practice. The working of the new board of health and the enforcement of the Medical Practice Act, of which the board were executive officers, have been very salutary, and have "accomplished more in the direction of medical education in our State [Illinois] than could have been done by any other means in the same or much longer time."

The "Sanitation of Small Cities" is the subject of a short, practical article from the pen of Dr. David Prince, in which the problems of the proper disposal of drainage and sewerage and the correction of unhygienic conditions of the soil are especially considered; the former have much to do with the so-called zymotic diseases, the latter more particularly with malarial disorders and consumption.

The treatment of fractures, more particularly of the femur, received considerable attention at this meeting. After presentation of the report on progress in surgery by the committee, Dr. Truesdale read a paper advocating the triple inclined planes for the treatment of fractured femur; and Dr. H. Z. Gill presented a supplemental report to that of the committee, in which early reduction and correct apposition of the fragments, with retentive apparatus and extension are advocated, while some shortening may be expected from any method of management. Dr. Gill also contributes a practical paper on the Surgical Treatment of Croup, insisting upon the value of early tracheotomy and prescribing the method of performing it, with reports of successful cases.

In the Report on Obstetrics Dr. C. C. Hunt recommends hot-water

injections in uterine hemorrhage, briefly considers the conditions of delayed labour, three instances of which are given, and reports a case of ante-partum hour-glass contraction (tetanoid falciform constriction of the uterus, or organic stricture, probably the latter). Craniotomy and version were performed and extraction accomplished—the mother died on the fourth day. The condition here referred to and the result are very similar to those reported by Drs. Alfred Hosmer, E. R. Stone, C. A. Thompson, and others. The recommendation of Dr. Hosmer to perform Cæsarean section would seem, in the light of experience, to offer the best chance of recovery for the mother and the only one for the child; in default of an operation, several cases have perished undelivered.

"The Chiropodists" is the title of a paper by Prof. Edmund Andrews, in which much information is given of a specialty which bids fair to become "as legitimate and well defined as dentistry." The operation for the relief of ingrowing nails, performed by one of these artists, bids fair to become a permanent procedure. "Commencing on the side of the toe, a little outward from the border of the nail, he cuts out a narrow, elliptical, or rather lanceolate strip of flesh, leaving intact the natural border or fold of skin. By bringing the edges of the incision together with sutures, he draws the overlapping flesh away from the nail, and effects a permanent cure with the least possible injury to the natural relations of the parts."

It is unfortunate that the text of this otherwise excellent volume of reports is marred by careless proof-reading, as numerous errors are observed, which are not included even in the *corrigenda*. F. W.

ART. XXIX.—*A System of Medicine.* Edited by J. RUSSELL REYNOLDS, M.D., F.R.S., Professor of the Principles and Practice of Medicine in University College, London, etc. *With numerous additions and illustrations.* By HENRY HARTSHORNE, A.M., M.D., lately Professor of Hygiene in the University of Pennsylvania, etc. In three volumes. Vol. III., *Diseases of the Digestive, Blood-Glandular, Urinary, Reproductive, and Cutaneous Systems.* 8vo. pp. 990. Philadelphia: Henry C. Lea's Son & Co., 1880.

THE principal additions made by Dr. Hartshorne to the third volume of the American edition of Reynolds's "System of Medicine" are articles on Cholera Morbus, Cholera Infantum, Pernicious Anæmia, Spermatorrhœa, and Trichina Spiralis. But everywhere throughout the volume, as in its predecessors, will be found, in the shape of numerous notes, evidences of the care with which he has prepared it for publication. These supply omissions in the text or record of facts which have come to light since the original publication of the work. In the articles on Ulceration of the Bowel and Dysentery he has also introduced several wood-cuts taken from the second medical volume of the "Medical and Surgical History of the War," which was fully reviewed in the number of this Journal for last January.

Dr. Hartshorne regards cholera infantum as essentially an entero-colitis. He admits, however, that in addition to this morbid condition there are changes in the blood and evidences of derangement of the ganglionic nervous system—a view of the pathology of the disease which was specially insisted upon by Sedgwick and adopted by Meigs and Pepper. We are

glad to find him urging the use of cold baths and of minute doses of calomel in the treatment of this disease. It is not at present necessary to say much in advocacy of the former method of treatment, but it will perhaps not be out of place to state that our own experience fully confirms Dr. Hartshorne's statement as to the value of calomel in the early stages of cholera infantum. Commencing practice about the time that Bennett's writings had produced a distrust of this remedy in the minds of the profession, we naturally fell into the popular error of regarding it as worse than useless. A little later, when we had opportunities for observing its effects for ourselves at the largest dispensary for children's diseases in Philadelphia, we were forced to the conclusion that no other medicine controlled the vomiting of this disease so effectually as it does. We agree with him, also, in condemning the employment of purgatives in this disease, but are disposed to make an exception in favour of the saline cathartics, which we have known to be of service.

In concluding this notice it gives us pleasure to recommend most cordially this "System of Medicine," not merely to the student, but also to the busy practitioner of medicine. J. H. H.

ART. XXX.—*The Principles and Practice of Gynæcology.* By THOMAS ADDIS EMMET, M.D., Surgeon to the Woman's Hospital of the State of New York, etc. Second edition, thoroughly revised. 8vo. pp. 875. Philadelphia: Henry C. Lea, 1880.

THE appearance of a second edition of this work in so short a period justifies the high estimate we placed upon its merits, and must be peculiarly flattering to the author. In a very brief preface he states that he has taken advantage of the opportunity to make a thorough revision, which has extended to every page, and several parts have been re-written, and some new matter added. There are evidences of this throughout the volume, both as to text and illustrations. Doctrines have not changed, nor could those do so which are based upon clinical observation, but some statements have been modified and placed in different language. Some portions of the previous edition were written in a tone which seemed hostile to the profession at large, and apparently indicated a feeling towards it which we were confident the author did not cherish. The suggestion was hazarded that this arose from opposition to, or criticism of, some peculiar views and some new doctrines taught by him which varied from those heretofore accepted. Whether correct or not, the time which has now elapsed since the first edition appeared has been ample for these views to be challenged and refuted if not correct. This has not been done to our knowledge, and the fact that it has not must be satisfactory to the author. Take the subject of laceration of the cervix: during the year which has now elapsed since the appearance of the first edition, we believe the current of professional opinion has set strongly in favour of the great value of Dr. Emmet's discovery as to the pathological importance of this lesion, and as to the efficacy of the operation for its cure. The recognition of his services in advancing practical knowledge and increasing the power to relieve and cure, is more manifest every day. When substantial benefits have been conferred it would be captious to attach any

great importance to the language used by a man thoroughly in earnest in presenting his views.

The short time which has elapsed since the former notice relieves us of the necessity of going into any detailed examination of the work. The closing pages of this edition are, however, worthy a moment's attention as showing the splendid results of the antiseptic method of performing ovariotomy and its influence upon practice. Dr. Keith has operated sixty-six times without a death, and Spencer Wells has had but six deaths out of eighty-one cases since he has adopted the antiseptic method! The effect of this upon practice has been revolutionary.

"Experience has already demonstrated that, with the antiseptic method, we are justified now in undertaking the removal of ovarian tumours at a much earlier stage of their growth. In the greater number of cases from a year to eighteen months can be gained; and many advantages can be claimed in favour of the operation as soon as the tumour rises out of the pelvis. . . . With these advantages in connection with the antiseptic method, the rule, as to the best period in the growth of the tumour, for its removal, has been reversed, and, as Dr. Keith has stated, ovariotomy is not the operation it was even two years ago."

A striking instance of the rapid advance we are making even in a field which, it would seem, could present no opportunity for anything more brilliant than had already been achieved.

As "spaying," or "Battey's operation," is still on trial before the profession, it may be noted that the author adds one more indication for its performance to those of the former edition: to "threatened insanity, epilepsy, or phthisis," he appends "the arrest of hemorrhage from a fibrous tumour."

The favourable reception accorded to this work abroad must be an additional gratification to the author, as it must be considered the highest testimony to its merits. When a book crosses the seas it passes beyond the range of the partiality of friendship, and of any adverse influence of personal feeling which may exist. The high encomiums generally bestowed by the British and European journals bear witness to the fact that Dr. Emmet's work is a valuable and worthy addition to American medical literature. J. C. R.

ART. XXXI.—*The Microscope in Medicine.* By LIONEL S. BEALE, M.B., F.R.S., Professor of the Principles and Practice of Medicine in King's College, London, etc. Fourth edition, much enlarged. 8vo. pp. 530. Philadelphia: Lindsay & Blakiston, 1878.

THE encyclopediac character of this last edition of Dr. Beale's well-known work, "The Microscope in Medicine," renders it impossible to present even an abstract of its contents. Suffice it to say that anything in his department upon which the physician can desire such information as is furnished by the microscope will be found here, and much more, in addition. When the topics treated of are so numerous it is difficult to adopt a systematic arrangement, but we have sometimes thought that the work might be improved in this respect. The present much enlarged volume retains the original method, but with the assistance of the very copious index, both of contents and illustrations, it is comparatively easy to find what one wants.

Dr. Beale retains his original views with regard to cell life, and of the nature of contagium. He rejects totally the bacterium hypothesis of contagium, and adduces arguments against it. He ascribes contagious diseases to the action of the contagious bioplast, a living particle of matter, in most cases less than $\frac{1}{100000}$th of an inch in diameter, derived from the organism affected by the contagious disease, and capable of exciting the same disease under appropriate circumstances in the organism of another individual. Like the pus-bioplast, it is "originally derived by direct descent from the bioplast of the body of man or animal, and is not of the nature of bacteria or akin to any low form of vegetable organism."

We were also much interested in reading Dr. Beale's section on tubercle. Here again he takes exception to modern doctrines, as to the histology, origin, and nature of tubercle, but it seems to us with much less reason than he objects to the so-called germ theory of disease. It is true that the question of tubercle is at present a very unsettled one, and there is much speculation on the subject, but we do not think that the facts upon which this reasoning is based, are erroneous; in other words, we believe that our knowledge of the histology of tubercle is more precise and accurate than it has ever been, and that it is in the main correct, while that of its histogenesis and exact relation to other inflammatory products is as yet unsettled.

The close personal relation of Dr. Beale to the making of his work, in every particular, not only in authorship, but in the production of the illustrations on wood, close superintendence of the mechanical execution, such as is the natural consequence of immediate ownership, has resulted in the production of a book, which is a type of perfect execution. It is moreover, a storehouse of facts most valuable to the physician, and is indispensable to every one who uses the microscope in his profession. That there are still many who do not use it is much to be regretted, although the number of these is rapidly growing less. J. T.

ART. XXXII.—*A Text-Book of Physiology.* By M. FOSTER, M.A., M.D., Prælector in Physiology and Fellow of Trinity College, Cambridge. From the third and revised English edition, with Notes and Additions, by EDWARD T. REICHERT, M.D., Demonstrator of Experimental Therapeutics, University of Pennsylvania. With two hundred and fifty-nine illustrations: pp. 1030. Philadelphia: Henry C. Lea's Son & Co., 1880.

THAT the work upon our table possesses intrinsic merits of a high order is abundantly shown from the warm reception accorded it by the profession on both sides of the Atlantic. It rarely happens that a new book in any department of medicine reaches a fourth edition within three years from the date of its first appearance; this, however, has been the history of Dr. Foster's "Text-Book of Physiology." We speak of the volume before us as a new edition advisedly, for while the author's text is the same as that of the third English edition, which was noticed in the January (1880) number of this Journal, the additions of the American editor are so copious and important as to largely increase the book's sphere of usefulness. In notices of former editions we alluded to the ab-

sence of any reference to the physiological anatomy of the various organs, and the dearth of illustrations, as serious drawbacks to the value and general usefulness of Dr. Foster's work. These faults of omission have been intelligently and quite fully supplied by the American editor; and it is just here that we find the distinctive features of the present edition. These additions, inclosed in brackets, and interpolated throughout the text, amount to about one hundred and forty pages, including the illustrations which are increased from seventy-two to two hundred and fifty-nine. An occasional note is also introduced, pointing out the physiological action of a few of the more important drugs. So ably and so thoroughly has the editor performed his task that we have no hesitancy in saying that, in our opinion, the American edition is far superior to its English contemporary as a manual for the student or a book of reference for the practitioner. In its present form we confidently recommend this text-book to the student as a concise, clear, and thoroughly reliable exposition of modern physiology.

W. J. C.

ART. XXXIII.—*Physiological Laboratory, Harvard Medical School, Boston. Collected Papers*, 1873–1879. For private circulation. 8vo. pp. 205.

THIS is the title of a volume which contains the results of investigations in the Physiological Laboratory of the Harvard Medical School, during the past six years under the direction of Prof. H. P. Bowditch. Some of the papers are the following: Experiments on the Action of Bile in Promoting the Absorption of Fats, by Charles H. Williams, M.D.; Intestinal Digestion, by G. M. Garland, M.D.; The Lymph Spaces in Fasciæ, by Dr. H. P. Bowditch; Contribution to the Physiology of the Cortex Cerebri, by James J. Putnam, M.D.; Physiological Action of Thebain, by Isaac Ott, M.D.; Force of Ciliary Motion, by Dr. H. P. Bowditch; Absence of Resonance in the Fifth Right Intercostal Space diagnostic of Pericardial Effusion, by T. M. Rotch, M.D.; The Function of the Epiglottis in Deglutition and Phonation, by G. L. Walton; The Effect of the Respiratory Movements on the Pulmonary Circulation, by Drs. Bowditch and Garland; Growth as a Function of Cells, by Charles Sedgwick Minot; and a description of the apparatus in use in the laboratory by Dr. Bowditch.

Most of the papers have been published in the *Boston Medical and Surgical Journal*, some in the *Journal of Anatomy and Physiology*. The first two were prize essays of the Boylston Medical Society for 1874. All are valuable contributions to anatomy, physiology, and clinical medicine, and show that work of this kind can be done at home as well as abroad, when opportunity is afforded. They reflect great credit alike upon their authors and director, Dr. Bowditch.

J. T.

QUARTERLY SUMMARY

OF THE

IMPROVEMENTS AND DISCOVERIES

IN THE

MEDICAL SCIENCES.

ANATOMY AND PHYSIOLOGY.

The Origin of the Blood-Corpuscles.

Of all the scientific monographs produced during the past year, few can rival in interest a paper by Professor RINDFLEISCH, entitled "Ueber Knochenmark und Blutbildung," and published in a recent number of the *Archiv für Mikroskopische Anatomie*. In this monograph, the red marrow of the cancellous tissue of bone is considered to be the chief source of red blood-corpuscles. We will summarize as follows the arguments by which the author supports this bold theory.

In red marrow are found certain cells, with reddish-yellow homogeneous protoplasm, and distinct nuclei—cells resembling in every respect the nucleated red corpuscles of fœtal blood. The spleen bears similar corpuscular structures, and is recognized as a seat of blood-formation. The red marrow, then, has the same function. In different morbid conditions, the blood has been explored, but without any significant results only in anæmia and leukæmia. Smaller and larger forms of nucleated red corpuscles have been detected under these and other circumstances. But what is the connection between them? This question has particularly occupied the author's attention. First, he explored the vascular relations of red marrow. No structure is so difficult to inject; for the periosteal and Haversian arterioles and capillaries, generally empty after death, are easily injected, but the vessels of the marrow are then full of blood. By certain precautions, Rindfleisch succeeded in making satisfactory injections of the marrow in the cancellous tissue of the ribs of guinea-pigs; by these same precautions, too, he found that the red marrow is red through its blood-forming cells, and not through the colouring matter of the blood within or escaping from its vessels.

The afferent arteries of the narrow-meshed capillary plexus of the marrow are slender; they penetrate to the middle of the medullary canal, and end as thin twigs running almost parallel to the axis of the bone, and, branching frequently at acute angles, they join the capillaries at a few points near the surface. These arteries hold hardly one-twentieth of the injection necessary to fill the veins and capillaries together. The veins, relatively thick, unite in every medullary cavity into at least one main trunk, which appears beset on all sides by its short secondary venules, the recipients of groups of true capillaries. At distinct points, emissary vessels leave the trunk for the surface of the bone. Hence red marrow

has a very complete vascular system, hitherto unrecognized owing to the difficulty of injecting that structure.

Professor Rindfleisch then enters into a disquisition on the variations of blood-pressure, and on the mechanism by which such variations are almost nullified in parts where they would do mischief. He refers, at some length, to the well-known nature of the cerebral circulation. The brain is encased in an unyielding capsule. Pressure from within and from without the cerebral vessels is counteracted by this arrangement; the thin walls of the arteries of the brain show how the duty of resisting pressure is taken from them. Diminution or increase of blood-pressure rather aids the exit of blood from the cranium than induces anæmia or congestion of its contents. Yet the brain is, to a certain extent, amenable to slight accommodations of pressure through another mechanism: the cerebro-spinal fluid. Not so the bone-marrow; for it contains no similar fluid, and is inclosed in an absolutely unyielding capsule. Hence, says Rindfleisch, there is no question of any variations of pressure affecting the blood within the medullary vessels and the medullary structures outside them. The marrow, to carry on its important functions, is thus shielded from a source of disturbance. If blood-pressure increase toward the bones, the blood-current in the medullary vessels cannot distend them, since the bone without makes them unyielding, so it has simply to go on faster. This happens when there is any improvement in the volume of blood during convalescence; and the result is the more rapid washing away of certain solid blood-elements, which are, under these circumstances, much needed to repair loss.

What influence has this mechanism of the circulation in the marrow on the structure of the walls of its vessels? The thickness of the walls of a vessel bears a direct relation to the amount of pressure it has to resist; this is proved by the vascular changes in hypertrophy of the heart, by the increasing thickness of capillaries towards their arteries and veins, and by the extreme thinness of the walls of the cerebral arteries. After consideration of the above conditions, why should we not demand a minimum of wall for the capillaries of the marrow? Why should they possess any wall at all? Hoyer maintained, in 1869, that the veins of marrow have no walls. Rindfleisch authenticates this assertion. The veins of the red marrow, as well as the greater part of the capillaries, possess no special wall; whilst the arteries possess an extremely delicate membranous coat, completely disappearing at the commencement of the capillary system. A thin cellular tunica adventitia invests the artery at its entrance into the medullary foramen, but is soon lost further on. Nothing remains but a single muscular coat, and a simple epithelial tube within it. The capillaries are sharply divided into an arterial and a venous set. The arterial are given out at acute angles from the ends of their arteries; they are spread regularly, but not abundantly, over the whole marrow. They still possess a membrane, with long rod-shaped nuclei. Towards the venous capillaries these nuclei become longer and thinner, crossing each other and forming a kind of trellis-work, which probably represents not so much a wall as the dissolution of the closed walls of the vessels into the surrounding parenchyma. In torn fragments of medullary tissue, the arterial capillaries may readily be distinguished from the venous by their lesser calibre and straight course, and especially by the presence of a nucleated membrane on the surface of the blue mass of injection which fills their lumen after preparation.

The venous capillaries, having no walls, are difficult to study. Their calibre is twice or three times as great as that of the arterial capillaries. Their surfaces, or rather the limits of the injected medium, possess numerous offsets, which throw out thin straight tertiary branches, running in opposite directions, parallel to the axis of the vessels. Plastered all over the injection, filling these twigs,

and projecting into their lumen, are large cells identical with those of the rest of the red marrow—a striking proof of the indefinite limitation of these vessels. The venous capillaries curve considerably as they enter the trunk veins. After the most careful experiments, Rindfleisch came to the conclusion that the veins are widely dilated sinuses, without walls, and running through the midst of the blood-corpuscle-forming medullary tissue. Through this arrangement, the productions of that tissue are readily abstracted and carried into the circulation.

To find the component parts of the medullary parenchyma, the vessels must be first thoroughly washed out with a weak solution of chloride of sodium. Then the observer may be sure he has only the parenchyma to deal with. First are seen the reddish-yellow nucleated cells. There is not one hair's difference between them and the nucleated red-corpuscles of fœtal blood. In the uterus of a guinea-pig, Rindfleisch found fœtuses in remarkably different stages of development at the same time. In the blood of a fœtus, five *millimètres* long, the nucleated were still in great majority over the non-nucleated corpuscles. The resemblance of the nucleated form to cells of red marrow was evident. As to their nuclei, no well-defined nucleoli could be detected, not probably from their being absent, but because their substance passes insensibly into the substance of the nucleus, as in all young rapidly proliferating cells. The nucleus is never in the middle of the red marrow cells. This is their great distinction from the permanently nucleated red corpuscles of the lower vertebrata. In the spleen of a bird, the equivalent of our hæmatoblasts can be found, but always with central nuclei. Of the significance of the non-central position of the nucleus in mammals more will be said presently. This nucleus appears separated from the protoplasm by a dim granular halo.

These nucleated red marrow cells undergo fission, commencing at their nuclei. The more quickly this process proceeds, the smaller will be the resulting red corpuscles. This point must be remembered with what was said above with regard to increased blood-pressure during convalescence, and what will be found below with regard to the appearances of blood at stated intervals in recovery from hemorrhage. Besides these cells, leucocytes abound in marrow. There are also "great-celled elements," probably altered forms of the marrow-cells just described; and also the well-known giant-cells, which Rindfleisch looks upon as deposits of formative material that has not been wanted. The absence of lymphatic vessels in marrow accounts for this accumulation. All the above cellular elements are considered by the author as organs of sanguification, and as no part of the permanent parenchyma, which consists of stellate fibres, composed of protoplasm, partly displaced by fat-cells. By a simple process of fatty degeneration, the red marrow becomes yellow.

Through what process, then, are the non-nucleated red blood-corpuscles developed from the nucleated hæmatoblasts of the marrow? Precisely in the same manner as the nucleated cells in the embryo precede the non-nucleated form. Rindfleisch searched specimens of marrow from numerous fœtal guinea-pigs. "Many a female guinea-pig," says he, "had to lay down her life without yielding that which was sought for." But at length he found four embryos, in which he could detect the transition of nucleated into non-nucleated blood-cells. He observed the nucleus, surrounded by a little colourless protoplasm, in the act of quitting the cell and leaving behind it a bell-shaped reddish-yellow structure, almost identical in form with a non-nucleated blood-corpuscle. This process must go on with great rapidity when it is necessary to make up for loss of cells from menstruation, anæmia, or debility. The bell-shaped body, being composed of soft, somewhat elastic material, soon assumes a rounded form when set free from its bed in the marrow and rolled along in the circulation, proceeding in one

direction; so that it has the pressure of the stream behind it and the pressure of the resistance of the blood in front of it, which determine the biconcave form of the perfect red blood-corpuscles. The nucleus left behind accounts for the free nuclei which may be found in red marrow.

When fresh blood-corpuscles are required to make up for the loss of blood by accident or disease, the blood-pressure, increased by certain influences towards the medullary cavity, necessitates the exit of an extra supply from that cavity as fast as its entrance therein, since the blood is passing through unyielding structures. Red corpuscles are more rapidly formed. Rapid fission of the hæmatoblasts taking place, the corpuscles, under these circumstances, are smaller than normal. After bleeding a guinea-pig, its blood was examined on the third day, and numerous small red corpuscles were found side by side with those of natural dimensions. The number of these small bodies increased till the seventh day, then they diminished; so that, about the fourth week after the bleeding, not one single small corpuscle was to be found. In the blood of women after menorrhagia, similar bodies were detected, ultimately disappearing; and neither in this nor any other form of hemorrhage could an increase of white corpuscles be discerned. The deduction thus suggested by Professor Rindfleisch is obvious.

That in animals where the red blood-corpuscles are permanently nucleated, these, too, are developed from hæmatoblasts, there can be no doubt. Besides, from examining sections of the spleen of a young dove, proofs have been found of the origin of hæmatoblasts from white blood-corpuscles or leucocytes. The spleen is the chief blood-forming organ in birds; in mammals it plays a great part, being a store of hæmatogenous tissue supplemental to the blood-forming red marrow. Why the cells of the marrow have this tendency to form corpuscles is a question unsolved, but which does not refute Rindfleisch's theory. What has the marrow (says he) in common with the spleen or the blastoderm? Yet the two latter, quite different structures, have long been admitted to aid in the formation of blood. After extirpation of the spleen, vicarious sanguification has been found to be established in the mesenteric glands. In an anæmic child, rachitic and with general sclerosis of the cancellous tissue of the bones—which, of course, implied great changes in the red marrow—the greater part of the lymphatics, and even the cellular tissue in the tubes of the kidney, was discovered to be hæmatopoietic. Rindfleisch concludes by admitting that M. Hayem, in 1877, already pointed out the identical nature of certain cells in the blood and in the red marrow. In the small red-corpuscles found in the blood of convalescents, we recognize the French physiologists' "*globules nains*" described in the eighty-fourth volume of the *Comptes Rendus*.—*British Med. Journal*, May 22, 1880.

MATERIA MEDICA AND THERAPEUTICS.

On the Mydriatic Properties of Homatropin.

The discovery of a new mydriatic is a matter of practical interest to the ophthalmic surgeon. To atropia there are many objections; in some instances it is so irritating that it cannot be endured; and in all cases, when applied for the purpose of temporarily suspending the power of accommodation in order to make manifest the real state of the refraction of the eye, its effects continue an inconveniently long time. But much more serious than either of these is the proneness of atropia to precipitate an attack of acute glaucoma in certain conditions of the eye which otherwise call for the use of a mydriatic. Mr. JOHN

Tweedy and Dr. Sydney Ringer (*Lancet*, May 22, 1880) bring to the notice of the profession homatropin, which promises to be of very great value and utility in ophthalmic practice. It is a bland and efficient mydriatic, rapid in its action, and of comparatively short duration.

Homatropin appears to possess many of the properties of atropia, but in a weaker degree. It must, however, be distinctly understood that, though relatively weaker than atropia, its action on the iris and ciliary muscle is really very powerful while it lasts. It is not merely weak atropia in the sense that it only does what a weak solution of atropia would do. A solution of the homatropin of the strength above mentioned widely and fixedly dilates the pupil in from fifteen to twenty minutes, and affects the accommodation in an equally rapid manner. The chief peculiarity, and in some respects the great advantage, of homatropin, is that its effects soon pass off, and certainly do not last anything like so long as those of atropia. Within four and twenty hours after an application the accommodation, after complete apparent suspension, recovers its pristine vigour, the pupil is less dilated, and reacts to light, though it has not quite regained its original size. As regards its action on the ciliary muscle, though decidedly more prompt, it is not quite so intense as that of atropia. Homatropin is, moreover, singularly unirritating. I have applied it to about fifty cases, and in not one was there the smallest sign of irritation or discomfort.

The homatropin used was obtained from Mr. Martindale, No. 10 New Cavendish Street, London.

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Hypodermic Injection of Pilocarpine.

Dr. Ciaramelli (*Giornale Internat. delle Scienze Mediche*, Anno 1, Fasc. x. xi.) contributes a carefully written paper on the therapeutic and physiological action of jaborandi and its alkaloid, as observed in his own practice. He has frequently administered the drug in cases of recent and large pleuritic effusions, but could never altogether satisfy himself that any benefit had been derived from this treatment. On the other hand, he witnessed very satisfactory results from the use of jaborandi in acute rheumatism, and in anasarca depending on acute or subacute nephritis, of which latter he gives two interesting cases. He recommends the following method of prescribing the drug, viz., jaborandi leaves three grammes (46 grains); infuse into 150 grammes of warm water; add two grammes of acetate of ammonia; and 25 of syrup; mix; the dose is one tablespoonful daily. As regards pilocarpine, its physiological action may be considered under two divisions, namely, the constant and inconstant; among the former he enumerates flushing of the face, a sense of heat, salivation, perspiration, rise of temperature, increased frequency of pulse and respiration; among the latter, an increase in the quantity of urine voided (in which he differs from most observers), and an increase in the nasal and lachrymal secretions. He saw vomiting occur only in one instance, and never saw any augmentation of the bronchial or intestinal secretions. He considers the phenomena induced by pilocarpine to depend partly on acceleration of the circulation, with increased tension, especially in the peripheral capillaries, and partly on a specific action exerted on the nervous centres.—*Lond. Med. Record*, May 15, 1880.

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The Stigmata of Maize.

It is hardly a year since this remedy was first introduced into the ordinary routine of practice, and yet it may not be uninteresting to make an abstract of some of the papers which have been published in regard to it. Prof. Castan, at the Montpellier meeting, called attention to the stigmata of maize as a remedy

which he had long known, and which he had found to be of great use in gravel and nephritic colic. In the latter disease there ensued after the administration of the drug a marked decrease in the painful symptoms, and he therefore supposed that the stigmata acted less as a diuretic than as a local anæsthetic. Prof. DENUCÉ, of Bordeaux obtained the most favourable results from its use in vesical catarrh, in which it appears to possess an elective action on the mucous membrane of the bladder. Dr. PONS, of Nérac, and Dr. QUEIREL, of Marseilles, had also frequently employed the stigmata of maize. M. Queirel observed that the pain was greatly alleviated in nephritic colic after the use of the remedy, but the urine was at the same time markedly increased in quantity. At the Therapeutic Society, M. CONSTANTIN PAUL stated that he was not convinced of the diuretic properties of the stigmata, although one of his colleagues had obtained some very striking results, the quantity of urine being in one case of dropsy increased from 500 to 1500 grammes after the ingestion of three spoonfuls of the syrup. Dr. LANDRIEUX has arrived at the following conclusions based on a considerable number of observations. (1) The various preparations of the stigmata of maize are of use in modifying the secretions of the urinary tracts. They may also be considered to possess a distinctly diuretic action. (2) The diuresis is rapidly produced, and the increase of urine is very marked after three or four days. (3) The diuretic effects are observed, not only in diseases of the organs concerned in the urinary secretion, but also in affections of the vascular system (diseases of the heart, bloodvessels, etc.). (4) The pulse is regular, the arterial tension is increased, whilst the venous pressure is diminished. (5) The remedy produces no disturbance of the nervous or digestive systems. The tolerance of the drug is complete and absolute, whilst in chronic cases its administration may be continued for three to six months without inconvenience. The different results which the use of the stigmata of maize has given at the hands of different observers, appear to be due in large measure to the fact that the strength of the extract varies, according to the nature of the soil, to the climate, to the time, to the mode of picking, and to the manner of drying the stigmata. The formula for the preparation of the syrup is not yet fixed, since the quantity of the active principles varies in different samples of the stigmata. The *Pharmaceutical Union* adopts formulæ which contain in one case six, and in another twelve grammes of extract to the kilogramme of syrup. The latter receipt is based on the assumption of a strength of 12 per cent. This quantity appears, however, to be too small, since the best samples of stigmata yield 25 to 30 per cent. of extract, or on an average 27.5 per cent. The kilogramme of syrup will therefore contain 27.5 grammes with this strength (27.5 pro mille). The daily dose of the syrup will be two to four spoonfuls, representing about one to two grammes of the extract. In all cases the syrup should be used in preference to an infusion of the stigmata of maize.—*Practitioner*, June, 1880, from *Le Progres Médical*, Feb. 14, 1880.

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On the Employment of Catgut for the Ligation of Arteries in their Continuity.

Dr. EUGENE BOECKEL, Surgeon to the Strasbourg Hospital, reports (*Gazette Hebdomadaire*, Feb. 27 and March 10, 1880) eight cases of ligature of the larger arteries with catgut, and from a comparison of these with other more numerous cases, which were reported by English surgeons (Transactions of Clinical Society, *Lancet*, 1877, vol. ii., pp. 574, 725, etc.), he deduces the two following conclusions: 1. That a catgut ligature, properly applied, obliterates in a permanent manner even large arteries. 2. That the reunion by first intention is easily obtained after these operations, provided that the rules of antiseptic surgery are strictly observed. In his own eight cases the incision of the ligature was closed

in each at the end of three or four days. One of his patients (Case II.) left the hospital three days after the ligature of the brachial; another, seventy-nine years old (Case VIII.), got up ten days after the ligature of the femoral.

From the moment that immediate reunion becomes the rule after these operations, the field of surgery is wonderfully enlarged. We shall be able to approach the ligature of the subclavian artery within the scalenus, which until now has always caused death by secondary hemorrhage, as well as that of the primitive iliacus or hypogastric. And as for the ligations which usually succeeded with the old methods, after more or less prolonged suppurations, we can assert that the antiseptic dressing renders them so inoffensive that they are less exhausting to the patient than simple digital compression.

There is no further reason why we should seek for a better agent of deligation than catgut. While it is reabsorbed after a certain number of days, it none the less leaves the artery obliterated; it is a fact that has been verified too often to be any longer disputable. From what substance may we expect superior results? Undoubtedly, silk threads or metallic wires encyst themselves sometimes in the tissues without interfering with primary reunion. But they do not disappear, or, if so, only after long months, and often they cause suppurations which eliminate them even more slowly.

The only admissible objection to the use of catgut is that we do not always have on hand threads of this material which are of good quality. The country doctor and the army surgeon will often be obliged to do without them. Then, they may make use of a silk thread or a linen one boiled in carbolic acid; this thread is easier to prepare, to preserve, and to transport than catgut, and it is more like it, without, however, offering the same assurances for the success of the immediate reunion. But why surgeons, who are converted to the antiseptic method, should still reject catgut for ligatures of arteries in continuity, under pretext that it is not sufficiently resistant, I cannot explain, unless by the instinctive fear caused by its reabsorption. Experience and reasoning have proved equally that this fear is chimerical, and it ought not to prevent us in the future from making use of this valuable agent.

MEDICINE.

Fatty Embolism.

In 1860, H. Müller (*Würzburger Medic. Zeitschrift*) first observed the phenomenon of fatty embolism in man. While examining the eyes of a young man who had died of contracted kidney, he found that some of the choroidal vessels were filled with fat. This fat, to which he did not attach any importance, was supposed by him to have come from atheromatous patches in the aorta or other vessels.

Similar observations as to the presence of fat in the bloodvessels after death were afterwards made by several observers; but it was regarded as a mere curiosity till the appearance of a paper by Wagner in 1862 (*Archiv für Heilkunde*), in which, from the frequent occurrence of fatty emboli in pyæmic cases, and from the result of experiments on lower animals, the opinion was expressed that they were a common cause of pyæmia. The attention of German observers was now directed to this subject, and numerous monographs on fatty embolism have since that time appeared. Of these may be mentioned that of Bergmann, in 1863, who, directing his attention to the effects produced by the introduction of oil into the circulation, attributed the death which resulted in some cases to paraly-

sis of the heart and œdema of the lungs; of Wagner, in 1865, in which an attempt was made to trace the origin of the fat in forty-eight cases of fatty embolism observed by him, fifteen of these being cases of rapid death after severe injuries of the bones and soft parts; of Busch, in 1866, who demonstrated that, immediately after injury to the medulla of a bone, fatty embolism of the pulmonary capillaries occurred, that the fat entered the circulation through the opened veins, and that it never caused abscesses or inflammatory disturbances—that, in fact, fatty embolism was of little importance, being only dangerous when in very large amount; of Cohnheim, in 1872, who clearly pointed out the existence of two kinds of fatty emboli, a non-irritating form which occurs after subcutaneous injuries, and an irritating form, where the fat is derived from the immediate neighbourhood of a septic wound; and of Flournoy, in 1878, who showed, among other things, that the conditions necessary for the occurrence of fatty embolism were, sufficiently large openings in the veins, the presence of free fluid fat in the neighbourhood of these open veins, and a sufficient *vis à tergo* (generally an extravasation of blood), and that these conditions most frequently occurred in fractures of bones, less frequently in injuries of the soft parts and after amputations or excisions.

In a recent monograph on this subject (*Untersuchungen über die Fettembolie*) Scriba has discussed the whole question at great length, and has brought forward many valuable facts. In order to obtain a pure fatty embolism, apart from any septic infection, he boils oil before injecting it, and uses various precautions in its introduction into the circulation. He first inquires into the fate of fat injected into the veins, and, with the view of determining this, he introduces the oil into the bloodvessels of frogs, while he at the same time examines with the microscope the circulation in the lungs, tongue, etc. He has also tested the urine of patients who had suffered injuries to their bones. As the result of numerous experiments, he finds that fluid fat when introduced into the circulation is caught in greatest part in the capillaries of the lungs, forming emboli. A smaller portion passes on into the general circulation, and either forms emboli in various organs, or is excreted by the glomeruli of the kidney, and appears in the urine. In man, the emboli in the lungs become detached in about eight days, pass on into the general circulation, and in part form emboli in other organs, in part are excreted by the kidneys, while at the same time the emboli in the various organs become loosened, and may be caught in the lungs. This cycle may be repeated several times. The greatest part of the fat is excreted by the kidneys, only a small portion remaining behind in the body. In support of these views, he finds that, as a rule, after fractures, oil only appears at intervals in the urine. Thus, at first, it is found on the second, third, and fourth days; then it disappears, reappearing again from the tenth to the fourteenth day, and again for a third or fourth time, at intervals of six to ten days.

Fat, however, cannot be looked on as an indifferent substance; not only does it act mechanically, it also probably acts chemically. For it has been found that, when oil is shaken up with blood, the red blood-corpuscles are in great part destroyed, some fragments only of them being found, while hæmoglobin appears in considerable quantities in the fluid. And in like manner, when the urine is examined in cases of fatty embolism, blood-pigment is often found, and, where casts are present, these contain it in a granular form. According to some, fat exercises a directly deleterious effect on the heart; Scriba, however, does not admit this, but, on the contrary, holds that the cardiac disturbances which occur after injection of oil are solely due to the altered conditions of the circulation, from blocking of the pulmonary capillaries.

Scriba has further investigated the changes produced in the lungs by the fatty embola. Oil was injected into the veins, into the medulla of the bones, and into

the abdominal cavity of rabbits, and in all instances the pulmonary vessels were found to contain numerous fatty emboli. In performing these experiments, it was observed that rapid injection of the oil is more fatal than a slow injection. When injected into a vein close to the heart, an amount of oil which, introduced under high pressure, would cause immediate death, if injected slowly produces scarcely recognizable effects. The fatty emboli are bland, and are not, as Wagner supposed, causes of pyæmia or secondary abscesses. The fat does not pass through the walls of the capillaries, but the plug becomes loosened and carried on in the general circulation, as formerly described.

With regard to the quantity of fat required to kill an animal, he comes to the conclusion that varying amounts will be necessary, according to the *vis à tergo* and the distance of the point of entrance of the fat into the circulation from the heart. If the *vis à tergo* be but little or if the distance be great, so that the increased blood-pressure produced by the entrance of the fat is equalized before it reaches the heart, a healthy animal requires a very large quantity of fat to kill it. The shorter the road, and the greater the *vis à tergo*, the less is the quantity of fat required; but in no case does Scriba think that less than three times the amount of fat present in the femur of the animal would be able to cause death. On examining the animals which died of fatty embolism, it was found that the vessels of the brain were very markedly blocked with fat; while, when these emboli were absent, or only present in small numbers, death did not occur, even although the lungs were full of them. In no case did he find death occur from acute œdema of the lungs. He therefore concludes that, in pure fatty embolism, death occurs only in consequence of extensive embolism of the vessels of the brain and spinal cord, and is due to the arterial anæmia and consequent disturbances of nutrition produced by the emboli.

He gives the following as the characteristic symptoms of fatty embolism: presence of fat in the urine at intervals; transient attacks of dyspnœa; lowering of temperature; temporary slight hæmoptysis, without fever, and generally without dulness or *râles;* irregular action of the heart; collapse, with marked pallor of the skin and mucous membranes; at first, shallow respiration, at times interrupted by deep sighing inspiration, later Cheyne-Stokes's respiration; spasms of various kinds or paralyses, generally bilateral; diminution of reflex irritability.

Such are some of the chief facts made out by Scriba with regard to the phenomena of fatty embolism. The subject is certainly one of the greatest importance, and calls for further investigation. It is, indeed, strange that, in spite of the interest which it has excited abroad, it should have attracted but little attention in this country.—*British Med. Journal*, May 22, 1880.

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Starvation Fever.

At a late meeting of the College of Physicians of Philadelphia Dr. J. M. Da Costa reported three cases, occurring in the same family, of what he proposes to call "Starvation Fever."

The first case was a little girl, three years of age, pale, weakly, and irritable, who was seized, Jan. 1, with vomiting. She was very feeble, unable to sit up in bed, and complaining of giddiness. The next day the same symptoms persisted, and the pulse was small and very rapid. Subsequently there was marked fever, and the vomiting lessened; under quinia, beef-tea, brandy, and milk, the gastric symptoms disappeared. The fever was unattended with sore throat, eruption, or diarrhœa, was not of long duration, and by the ninth day from the beginning of the attack, the little patient, in good spirits, with appetite fully returned, was sitting up in bed playing, seemingly quite convalescent. On the 10th, vomiting returned; henceforth nothing was retained on the stomach; the child complained

of not being able to see, became weaker and weaker, and expired exhausted on the 13th. The *autopsy* showed yellowish serous effusion in both pleural sacs. There was no evidence of lymphy exudation on the pleura; the amount of fluid was sufficient to have compressed the lower lobes of both lungs; the upper lobes were healthy. The heart was normal. The stomach was empty, its mucous membrane dryish and very pale; the intestines exhibited no swelling of any of the glands. The spleen was slightly enlarged; the liver had a nutmeg appearance; the kidneys were normal. The dura mater was somewhat congested, but free from adhesions; the pia mater was opaque; the cortical portions of the brain were œdematous; the convolutions were deep. A section of the upper part of the brain showed punctiform injection; the lateral ventricles were dry; but there was some effusion in the fourth ventricle.

The second case, a younger brother, four months of age, also a pallid, ill-nourished child, was seized with convulsions Jan. 10th. There was no retraction of the head; the urine was not albuminous. He had had a convulsive seizure two months previously, leaving apparently no trace. The convulsions of the 10th lasted until nearly evening, and some hours afterwards death took place. In the afternoon a few dark spots, like very small petechiæ, were noticed on the neck, and shortly before death similar spots were detected in the hypogastric region. The *autopsy* gave results similar to those in the first case. In all the thoracic and abdominal organs, evidences of profound anæmia; some serous effusion in the pleural sacs; stomach pale, containing a small plug of casein; absence of signs of glandular enlargement in the pale intestines, and a rather fluid blood, were the points specially noticed. Permission to examine the head was not obtained.

The third case was a little girl a year and a half old. She, too, appeared ill nourished, and was on Jan. 8th attacked with fever, with which was soon associated an acute bronchitis, and subsequently a circumscribed broncho-pneumonia. There was no sore throat, eruption, or albuminous urine. The child was well sustained, and under quinia and stimulating expectorants she slowly recovered in two weeks, having been very ill.

Dr. Da Costa was at first at a loss as to the nature of these strange cases. That they were not cases of scarlet fever, or diphtheria, or typhoid fever, was self-evident, though it was equally evident that in some general cause producing profound alteration of nutrition, or in some blood poison, was to be sought the explanation. The convulsions, the eruption, the speedy termination in the second case, suggested cerebro-spinal fever; but spinal symptoms were wanting, and the phenomena in the other cases were not at all those of this disease. The question of poisoning from bad drainage was carefully considered; the drains were everywhere in good order, and there was no water-closet or stationary wash-stand near the rooms in which the children played and slept. The supply of water in the house was good, and none of the adults suffered in the least from its free use. Attention was then directed to the food, and here a clue was obtained, which led to an unexpected discovery. The children lived almost entirely on cow's milk; the two youngest, exclusively; the eldest, almost exclusively; and, though taking large quantities, they did not thrive. Chemical analysis showed that the milk was skimmed, and diluted with one and a half parts of water.

The nature of the cases then became clear. In the anomalous fever, the local congestions, the vomiting, the stains on the skin, the convulsions, the ready collapse; in the collection of fluids within the serous sacs, the thinness and pallor of the mucous membranes, were the phenomena of inanition or starvation, as they have been experimentally demonstrated. To call these cases "Starvation

Fever," would, Dr. Da Costa thinks, be fully justified. Yet the question remains, whether some cause, in itself of little importance, did not act as an exciting cause to bring about the crash; some cause like a passing influenza, which, throwing the least weight on functions and organs incapable of resistance, broke them down at once. The fact of all the cases happening about the same time, and the catarrhal symptoms in the third case, favour this view.

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Salicin in Acute Rheumatism.

At a late meeting of the Clinical Society of London (*Lancet*, May 29, 1880), Dr. GREENHOW, President of the Society, reported ten cases of rheumatic fever treated with salicin. He stated that for some years past he has been in the habit of testing carefully and methodically in a series of cases the several remedies from time to time proposed for the treatment of rheumatic fever. During the last three years he had treated in the Middlesex Hospital ten cases with salicin, and fifty with salicylate of soda. All the patients were confined to bed until the fever had entirely subsided. The diet consisted of milk, beef-tea, and sometimes eggs; stimulants were sparingly given; the affected joints were wrapped in cotton-wool, and, when pericarditis or endocarditis was present, belladonna and iodide of potassium ointment was applied over the præcordia. In most cases simple effervescing medicine was prescribed on the day of admission, and aperients and occasionally sedatives were given, but the latter as seldom as possible. In all the cases treated with salicin, and in many of those treated with salicylate of soda, the urine was examined the day after beginning the medicine, and found invariably to yield the characteristic reaction with perchloride of iron. In order to exclude cases of mild type which, especially in young subjects, rapidly improve under any kind of treatment, the salicin or salicylate was not prescribed until the patient had been from twenty-four to thirty-six hours in the wards.

Case 1. First attack. Incipient pericarditis. Salicin in full doses on day after admission. Temperature began to fall on third day, became normal on sixth. Pains abated on second day, and ceased on fifth. The salicin taken every two hours for six days, then for two days every four hours, and for nine days every six hours. A mild relapse occurred whilst taking the drug. Epistaxis occurred in this case, and the heart's action became feeble, requiring stimulants. Discharged on sixty-sixth day. Case 2. Sixth attack. Admitted on fourteenth day. Mitral disease and pericarditis. Pain diminished on second day of treatment, ceased on sixth day. Temperature fell on third day, and became normal on fifth. Salicin given every two hours for six days, then every four hours, but, a relapse occurring, the frequency was again increased to two hours. Vomiting and headache became so severe that, at the end of ten days more, the drug was discontinued. Pleurisy and a second attack of pericarditis occurred. Discharged on 107th day. Case 3. First attack. Ailing several weeks. Pericarditis. Pains rapidly subsided and temperature became normal on the fourth day of taking the drug, but cardiac failure was very marked, and the salicin was discontinued on the eighth day. Discharged with an apex systolic murmur on twenty-fifth day. Case 4. Third attack. Old mitral disease, and a recent basic murmur. Pericarditis supervened two days after salicin commenced. The temperature soon fell to normal, but pains and vomiting did not subside with it. A mild relapse occurred after the salicin was discontinued; iodide of potassium was given, and patient discharged on fifty-eighth day. Case 5. Third attack; relapse; pericarditis. Temperature normal, and pains greatly subsided on fourth day. Epistaxis supervened, and pulse became small and feeble on the third day. Discharged on twentieth day. Case 6. First attack

Temperature fell to normal, and pains subsided after two days' treatment, but pericarditis developed. Pulse became very feeble; vomiting and epigastric pain occurred nine days after commencement of treatment, unrelieved by reduction in frequency of the drug, which was discontinued on the eleventh day. A relapse occurred, but salicin was not prescribed again. Discharged on forty-sixth day. Case 7. First attack; third day. Temperature fell to normal on third day of treatment. Pains and vomiting subsided more slowly. Salicin continued till twenty-third day, and patient discharged on forty-fifth day. Case 8. Second attack; tenth day. Temperature fell to normal, and pains subsided within thirty-six hours from commencing to take salicin, which, at first given every two hours, was afterwards reduced owing to feebleness of pulse, and omitted on the twelfth day. Discharged on twenty-third day. Case 9. Second attack; third day. Complicated with pneumonia. Temperature became normal on tenth day; pains continued a day or two longer. Sounds and impulse of heart became very feeble on twelfth day. Discharged on thirty-third day. Case 10. Second attack; sixth day. Double pneumonia and hæmaturia; endocarditis and pleuro-pericarditis. Pains in joints disappeared on the seventh day of treatment, but temperature remained high until after the salicin had been discontinued, on account of persistent and uncontrollable sickness. Chloral and morphia were required frequently at night, and stimulants were freely given on account of the dyspnœa and feeble and irregular action of the heart. Twenty grains of salicin were given every two hours for seventeen days. It caused sickness at a very early period, and after a few days dryness and soreness of throat. Discharged on fifty-eighth day.

Thus the effects of the drug were not very satisfactory. The temperature appeared to be reduced and the pains to subside in the uncomplicated cases; but, in Cases 1, 2, 4, and 6, relapses occurred when the salicin was either discontinued or the frequency of the dose diminished. Case 5, one of relapse, had already been laid up some time, and recovery might have been as rapid under simple rest and diet; while in 9 and 10, complicated with pneumonia, the salicin did not appear to exert any influence on their progress. On the other hand, salicin appeared to produce some inconvenient consequences. In one case epistaxis, which recurred when the dose was increased; in four cases marked cardiac depression; nausea and vomiting in two cases. Lastly, the detention of the patients in hospital was not shortened by the treatment; for, except Cases 3, 5, and 8, two of which were approaching their close when admitted, the patients treated with salicin recovered more slowly than is common in cases of similar severity under other modes of treatment.

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Salicylate of Soda in Acute Rheumatism.

At the same meeting (*Ibid.*), Dr. GREENHOW also reported fifty cases of rheumatic fever treated with salicylate of soda. He discussed, first, the physiological, and then the therapeutical, effects of salicylate of soda.

One of the most obvious effects of the treatment in the majority of cases was a speedy fall in temperature, sometimes within a few hours from commencing the treatment, and, save in a few cases, within two or three days. The pulse usually, but not invariably, came down in frequency with the fall of temperature. In forty-five of the fifty cases certain well-marked physiological symptoms attended the reduction of the fever. There were effects on the nervous system, such as deafness, vertigo, headache, noises in the ears, delirium, and hallucinations. Deafness often occurred early, and was noticed in twenty-seven cases. Sometimes it was very intense. Vertigo occurred in fourteen cases. Very

intense headache, chiefly frontal, though less frequent than deafness and vertigo, was, when it occurred, a much more distressing symptom. It was complained of in nine cases, and in some recurred with the resumption of the medicine. Delirium was present in eight cases, hallucinations in four. Great depression of pulse and action of the heart was the most important effect produced on the circulation, more or less weakening of the pulse, calling for stimulants in almost every case, great weakening of the impulse of the heart, and in ten cases almost complete obliteration of the first sound; in some, an irregular or dicrotous pulse. Vomiting occurred in twenty-two cases; great injection of the tongue in many cases; soreness of the fauces in three, and an aphthous state of the tongue in three cases; diarrhœa in two cases was evidently referred to the salicylate; epistaxis occurred in seven cases; in two transient albuminuria was observed; in two others tremor of the hands and tongue, which may not have been due to the drug.

Speaking of the therapeutical value of salicin and salicylate of soda in acute rheumatism, Dr. Greenhow said that his experience led him to regard these as the most powerful antipyretic agents with which he was acquainted. The temperature soon falls under their use: the pulse commonly falls at the same time, and the pains soon abate very considerably, and in most cases entirely cease within a few days. But the improvement in the symptoms only takes place coincidently with the development of one or more of the physiological phenomena already described; and in all the most acute cases the relief derived from the medicine passed away soon after the treatment was intermitted, and a relapse—in some cases several relapses—took place. On this ground these agents cannot be regarded as in any respect specifics in the treatment of rheumatic fever. Excluding two cases, which passed into the state of hyperpyrexia whilst under the physiological influence of salicylate of soda, two other cases, which proved fatal, and about fourteen very mild cases, from which no conclusions could be drawn, there were relapses in twenty-one out of the remaining thirty-two cases. In seven of these twenty-one cases there was only one relapse; in nine there were two; in two there were three; in other two four; and in one five relapses. A proportion of twenty-one out of thirty-two was a large one for relapsing cases, and in most of the cases the relapse was due to the passing off of the influence of the medicine.

The paper concluded as follows: "Fully admitting, therefore, the great immediate relief that appears to follow the use of those agents in the treatment of rheumatic fever, there still remains for consideration the further question whether, upon the whole, the treatment is successful. The answer to this question must depend upon whether the complications which are apt to arise in rheumatic fever are less frequent under this treatment; whether the condition of the patient after recovery is better or worse than under other modes of treatment; and, lastly, whether the length of time during which the patient is disabled is shorter or longer under this than under other modes of treatment. To all these questions my experience leads me to reply in the negative. We might have, perhaps, expected that hyperpyrexia at least would have been prevented by the use of such a powerful antipyretic agent, but the first two cases I have recorded negative this expectation, for hyperpyrexia was developed in both of these after the proper physiological influence of the salicylate of soda had become manifest. Pericarditis was present in many cases before the treatment was commenced; but, in several instances, it supervened afterwards. In three cases pneumonia, and in four others pleurisy supervened, when the physiological effects of the medicine had become manifest. On the other hand, several cases that were admitted with either pleuro-pneumonia, broncho-pneumonia, or bronchitis ran very much the course we are accustomed to witness in similar cases under other treatment.

"Patients treated with salicylate of soda appeared to me to become unusually anæmic and to regain health and strength very slowly. They are long in becoming fit to resume their occupations, and their recovery has appeared to me more edious than has been the case with patients treated on other methods. Excluding the two cases of hyperpyrexia, the two fatal cases, and nine very mild cases, which were on the average less than twenty days in the hospital, and, perhaps, recurred neither more quickly nor more slowly than such cases commonly do, I find that the remaining thirty-seven cases were on an average fifty-seven days each in the hospital. This period, however, by no means represents the duration of their disabling illness, for all had been at least a few days ill previous to admission, and probably none was discharged in a condition to resume work, many having been sent to convalescent hospitals, and others to their friends in the country to recruit. If now we examine into the duration in hospital of the cases treated with salicin, a very similar result is shown. Two cases which were admitted in an advanced stage of their illness being excluded, the average residence in hospital of each of the remaining eight cases was fifty-five days. With regard therefore to the treatment of rheumatic fever with salicin and salicylate of soda, we must, I think, come to the conclusion that most physicians did with regard to the treatment with blisters—viz., that the pain and distress of the patients are undoubtedly for a time greatly assuaged, but that the duration of the illness is not shortened. Of the two plans, I am of opinion that blisters applied in the vicinity of all the painful joints are by far the most efficacious and speedy in the relief they afford, and have the advantage of not producing so much subsequent debility.

"Another question now presents itself for our consideration, namely, whether it is not possible that some injurious consequence may result from the powerful action of the medicine upon the heart; and I am bound to express my fears that the marked weakening of the first sound of the heart present in so many cases indicates the exertion of an influence upon the muscular structure of that organ, which may not always pass entirely away when the treatment is suspended, and more particularly when either inflammation of the endocardium or pericardium or of the muscular structure itself exists during the treatment."

Mr. H. DAVY said that having himself been thrice the subject of rheumatic fever his experience might be acceptable. He believed that it is a very difficult matter to rightly estimate the value of various kinds of treatment, and he could not help thinking that many physicians had arrived at different conclusions from those of the President. When house-physician at Guy's Hospital he had carefully watched some twenty or thirty cases, and from this experience he believed that, although these drugs do not prevent complications arising, they relieve pain and pyrexia, and that cases so treated are more free from complications and relapses than appeared from Dr. Greenhow's experience, nor had he seen any serious vomiting occur. After Dr. Maclagan's statement as to the superiority of the salicin over the salicylate, he had prescribed the former, and although hallucinations, light-headedness, deafness, etc., were frequent, they were of small importance in comparison to the amount of relief given to the patient. Relapses were quite as much due to a too early return to fish diet as to the drugs. In his own three several attacks he had been under different treatment; the first time—a mild attack—he was treated by a country practitioner with opium and bleeding; the second time, when the rheumatism was complicated with scarlet fever, he was treated by a London physician with alkalies and without milk. The attack was brief, but he was anæmic for some months after. The last time he prescribed for himself under Dr. Taylor's supervision. He took fifteen grains of salicin every two hours, and in two days the temperature had fallen from 103° to

normal, and in ten days he was out of bed; whilst taking the drug he had slight deafness and hallucinations.

Dr. H. Weber said that the results arrived at in his previous paper were indifferent, but the conclusion he came to was that the treatment was on the whole more successful than any treatment he had formerly applied. Since that time he had given these drugs in many cases, and his results had not been so unfavourable as the President's. He had found that, among forty-four patients treated with salicylate of soda, the average number of febrile days, including relapses, were fourteen; whereas in seventy cases otherwise treated the average number of febrile days were nineteen. He had not included the number of days in hospital, because in the German hospital most of the patients, being homeless, were retained longer than usual to prevent relapses. He thought that complications were not so frequent in cases treated by the salicylate; and since he had employed it he had not seen any cases of hyperpyrexia. As a rule, the urine yielded the perchloride of iron reaction on the first or second day of treatment by salicylic acid, but not by salicin. The author had not endeavoured to explain how salicylate of soda acts; he seemed to imply that it acted merely by reducing the heart's action. He himself (Dr. Weber) admitted this effect on the heart; but suggested that these drugs may act by a process of fermentation in the blood; for salicylate of soda diminishes the amount of sugar in diabetes. And he had found in cases where there is a rapid formation of bacteria in the urine, that the salicylate of soda diminishes this tendency.

Dr. Cavafy said that his own experience of these drugs in acute rheumatism dated from 1876, and he had frequently observed the effects of salicylate of soda given in considerable doses—*e. g.*, half a drachm every two hours at the beginning, with a subsequent diminution in dose and frequency. In some particulars his experience was not in harmony with Dr. Greenhow's; for instance, that improvement only occurs coincidently with the development of toxic phenomena. Only a small percentage of his cases showed toxic effects. Nor did he think too much importance should be given to those unpleasant symptoms of deafness, tinnitus, delirium, etc.; they were distressing, but did not result in permanent harm; and they could be controlled by remitting one or two doses, or they subsided when tolerance was established. The proportion of cases of albuminuria out of fifty was a small one, and probably due to some accident, rather than to the drug. The relapses depend much upon the time during which the drug is continued in small doses. After saturation with the drug, if its administration be continued in small doses for a longer time than usual, relapses may to a considerable extent be avoided—especially if the diet is kept low. To be sure, in some cases recovery was tedious, but that is often the case in rheumatism. Still, in cases which are moderately severe at the onset, it was possible to get the patient out of bed in five days. He had met with a case of a lady who had previously had two attacks of rheumatic fever, of long and tedious duration, confining her to bed for many weeks. On the third or fourth day of her third attack, temperature 102.8°, swelling of several joints, and turbulent cardiac action. She was placed upon salicylate of soda in twenty-grain doses, and within a week was up and about. There was no relapse. Dr. Greenhow's cases included two fatal ones. Had the drug any share in this result? The weakening of the first sound of the heart may be due to the pyrexia.

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A Rare Case of Vaso-motor Neurosis of the Lower Extremity.

At a late meeting of the Société Médicale des Hôpitaux (*Gazette Hebdomadaire*, April 9, 1880), M. Straus read a paper on the following rare case of vaso-motor neurosis of the lower extremity. A man, thirty-five years old, a

business employé, entered the Tenon Hospital on the 19th June, 1879, on account of rheumatic pains in the right shoulder and left foot. He had no fever, no cardiac complication, the pains lasted for eight days, and rapidly yielded to rest and salicylate of soda. The patient was considered convalescent, when M. Straus observed on the left lower extremity the following curious vaso-motor phenomena:—

Even when the patient is lying down, the foot and toes of the left side are the seat of marked turgescence with obliteration of the course of the tendons and red coloration of the skin. To the touch, there is a noticeable increase of temperature, in comparison with the healthy side. This turgescence, which is in no wise painful, does not extend beyond the ankle. The articulations of the foot and tarsus are entirely free and painless. When the patient is sitting down, with the legs hanging, the swelling and coloration of the members increase, especially on the toes and front part of the foot, without extending beyond the instep. The standing position still further increases the symptom, which reaches its maximum when the patient has taken a few steps; then the foot and toes of the left side become violet, as if phlegmonous, and the veins become conspicuous under the skin. There is no trace of varicose veins.

Walking is very painful, and can only be done on the heel alone; the patient cannot wear his shoe on the left foot; after a few minutes, even when making use of a crutch, walking becomes impossible. There are no disturbances of sensation, with the exception of pricking in the left foot; there is no paresis, or atrophy of the muscles, which respond readily to electricity.

He says, that on several occasions, during ten years of military service, after being fatigued, or after forced marches, he has felt pain and swelling in the left foot, which prevented him from walking for several days or even weeks. He was under treatment for rheumatic pains, neuralgia, etc.

These singular vaso-motor phenomena continued during the two months that the patient remained in the hospital. They were analyzed with care, especially the differences of temperature. Minute measurements were made almost daily, and showed a constant difference between the foot on the left, and that on the right side, increasing from 2 to 4 degrees centigrade, and varying according as to whether the patient was lying down, standing, had walked, had his legs covered, etc.

On the 6th of August, 1879, he was so much better, that he could put on his shoes, he could walk, and was taken to Vincennes, but the vaso-motor paralysis still continued, as well as the thermic modifications.

During the past winter the patient has been able to resume his trade, and to take quite long walks, but in spite of the severe cold he could not put his feet near the fire. The left foot is always turgid and highly coloured, and between the two extremities the difference in temperature is 2.5° Cent.

M. Straus refers to the important paper of Dr. Weir Mitchell, which appeared recently, and relates to cases which are almost identical (On a Rare Vaso-motor Neurosis of the Extremities, in the *American Journal of the Medical Sciences*, July, 1878). He also recalls analogous facts observed by M. Vulpian and M. Sigerson, and, finally, to a recent observation by M. Allen Sturge, of London (see *American Journal of the Medical Sciences*, July, 1879, p. 258). Perhaps the disease is not so rare as it has appeared to be, and is often confused with rheumatoid conditions, paralysis, varicose veins, etc. M. Straus finishes his communication by a comparison between this vaso-motor neurosis and that described by M. Maurice Raynaud under the title of local asphyxia and symmetrical gangrene of the extremities.

Do the vaso-motor disturbances in question (whether they be of a vaso-paralytic

or of a vaso-dilatative origin) relate, as thinks Dr. Weir Mitchell, to a disturbance of the vaso-motor medullary centres? M. Straus does not dare to decide, but he inclines towards an opinion broached by M. Vulpian on the subject of symmetrical gangrene of the extremities, and according to which these vaso-motor disturbances would not necessarily proceed from a central spinal origin; they could result from the modifications (reflex or otherwise) sustained by the numerous peripheral ganglia which exist near the terminations of the nerves in the vessels, and which control, in part, their innervation. The clearly defined *unilaterality* of the vaso-motor disturbances, in this case, seems to be an argument against the spinal localization of the disease.

M. Dujardin Beaumetz stated that he had been attacked by symptoms similar to those described by M. Straus. But their etiology was different. They appeared in consequence of the rupture of the tendon of the left patella.

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Eruptions Caused by Internal Use of Chloral.

The facts recorded at a late session of the Société de Médecine Pratique (*Bull. Gén. de Thérapeutique*, Feb 15, 1880), complete the inquiry opened in London, which has been made the subject of a report by Doctor Farquharson to the Clinical Society of London, and which we published in our last number (see p. 533).

M. Brochin made a communication on the inconvenience of chloral, and reports the case of a young strumous girl who was attacked with eczema of the lips, who, on two different relapses, saw the affection return immediately after the administration of a potion and a wash of chloral, and that with such intensity that the mouth and tongue were attacked; this curious case of buccal eczema has been submitted to the diagnosis of M. Bazin, who confirmed it.

M. Limousin stated that he was acquainted with these facts of chloralism; the eruption consists in a reddening of the face, almost like erysipelas, disappearing with the suppression of the medicine.

M. de Boyer has seen in M. Bouchut's practice these scarlatiniform eruptions, but without angina, develop themselves in the cases of choreic patients submitted to large doses of chloral. They disappeared spontaneously.

M. Gillet de Grandmont has observed five analogous cases with manifestation of erythema on the eyelids and around the neck.

M. Grellety has noticed that the irritating contact of the chlorine with one portion, and its elimination from the other, must play the principal part in the production of this singular buccal eczema; but this erythema is controlled by an individual susceptibility which is often met with among the dermopathies; it is thus that the use of alcohol, and of coffee is sufficient to act as a spur to certain eczemas; in all cases there exists a personal idiosyncrasy for which we must make allowance from a therapeutic and dietetic point of view.

SURGERY.

On New Methods of Removing Intra-laryngeal Growths.

To the two well-known methods of removing laryngeal growths, viz., the intralaryngeal operation, in which the growth is removed by various forms of knives, forceps, etc., through the mouth with the aid of the laryngoscope, and the extralaryngeal operation, or thyrotomy, in which the thyroid cartilage is split in the middle line and the growth removed through the wound, Professor

ROSSBACH, in the *Berliner Klinische Wochenschrift*, No. 5, 1880, adds a third. His operation is a subcutaneous one. Professor Rossbach states that it is easily and quickly performed, is almost painless, requiring no anæsthetic, is attended with the escape of only a drop or two of blood, and is quite devoid of danger; the wound, moreover, heals very rapidly, and requires no after-treatment. A small spear-pointed knife is introduced through the middle line of the thyroid cartilage, a little below the notch, and is pushed through the mucous membrane into the larynx. With the aid of the mirror the knife is then guided to the growth, and its pedicle or base cut through. After the first prick in the skin, the patient experiences no further pain. He does not feel the entrance of the knife into the larynx, and its presence there causes neither coughing nor gulping. Should, however, any such spasmodic movements accidentally occur, the knife need not be withdrawn, but may be allowed to remain passively in the larynx, the handle being merely supported by the thumb and forefinger placed lightly on the thyroid cartilage, so that during the up and down movement of the larynx the hand, knife, and cartilages move as one piece. With this precaution, wounding of the mucous membrane will be prevented. Professor Rossbach has operated by his method on two patients with entire success. He has also demonstrated, in a large number of experiments on animals, the ease with which the knife can be manipulated in the larynx when introduced subcutaneously. In this way, he states, he has removed in animals both vocal cords, and in one case has separated the whole of the mucous membrane from the interior of the larynx. Professor Rossbach was led to devise his operation in consequence of having failed to remove a polypus from a patient who could neither tolerate the presence of instruments in the larynx when introduced in the intralaryngeal manner, even after months of practice, nor would submit to thyrotomy. The advantages of this operation in such cases he considers obvious. But he also thinks it preferable in a large number of cases usually treated in the intralaryngeal way, since it is more easily performed than the latter operation, and causes much less inconvenience to the patient.

In the same number of this journal, another operation for removing laryngeal growths is described, which, however, is only a modification of what is generally known as subhyoid pharyngotomy.

Dr. CARL LANGENBUCH, after administering an anæsthetic, makes a transverse incision through the skin between the hyoid bone and thyroid cartilage, separates the muscles from the hyoid bone, and cuts across the thyro-hyoid membrane immediately above the upper border of the thyroid cartilage, and then makes a median incision through the three-cornered portion of the membrane which lies in the notch of the thyroid cartilage, continuing this incision, as he says, perhaps unnecessarily, through the upper third of the thyroid cartilage. He next divides the root of the epiglottis, and exposes the interior of the larynx by drawing the thyroid cartilage downwards and forwards by means of strong hooks, so that the growth can be removed through the wound. The operation is attended with but very slight hemorrhage. Dr. Langenbuch states that he has not found this operation described in the larger works on surgery; a similar method of opening the larynx was, however, employed by Professor Roser in 1851 when making some experiments upon animals.—*London Med. Record*, May 15, 1880.

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Nephrectomy by Abdominal Section.

At a late meeting of the Royal Medical and Chirurgical Society (*Lancet*, March 13, 1880), Mr. A. BARKER read a very interesting paper on this subject and re-

ported an unsuccessful case in which a movable kidney affected with encephaloid was extirpated.

Mr. Barker stated the reasons which induced Prof. Simon, of Heidelberg, to plan and carry out in 1869 the first case of nephrectomy designedly performed on the human subject. He shows that Simon had been preceded by two American surgeons in the mere removal of the kidney. He points out the importance of Simon's experiments on animals, and his main conclusions therefrom—1. That this operation is as well borne in the first instance by the system as others now fully recognized, such as excision of the uterus or ovary. 2. That the sudden removal of one kidney does not so far affect the urinary functions as at all to influence the question of the operation. 3. That the health of the animal may be quite as good after as before, and without any uræmic troubles, hypertrophy of the heart, or other evils.

The question as to whether these conclusions hold good for man is then shown to have been settled in many respects by the effect of the operation in Simon's first case, and in many since recorded. Of these the author has collected twenty-eight from home and foreign sources in which from various causes a kidney has been removed. These he tabulated under the headings "operator's name," "sex and age," "diagnosis or object of operation," "duration of complaint," "date of operation," "situation of incision," "form of dressing," "treatment of pedicle," "symptoms after operation," "result, immediate and eventual," "hemorrhage after or at operation," "condition of organ removed," "remarks" on points of interest about the various cases. From this list two cases are first quoted which seem to prove more conclusively than any experiments on animals that neither the incision down to the kidney in the loin, nor the ligature of its pedicle and its removal, need cause any great disturbance in the system. In neither of these cases did this result. The organ in both had been wounded by a stab with a knife, and prolapsed, and was removed easily and without any ill effect. It was the study of these and a number of the others tabulated which led the writer to operate in the present case. He found that out of the twenty-eight attempted nephrectomies, six were done on a wrong diagnosis; in two for neoplasms the operation was left uncompleted, owing to difficulties experienced in the isolation of the organ. Of the remaining twenty undertaken with the distinct object of removing the kidney and completed, the objects were the following: Two for fistula of the ureter, both successful; two for acute pain in the kidney (cause unknown), one death, one recovery; two for calculous pyelitis, both fatal; three for injury of the organ, two complete recoveries, one fatal; six for acutely painful movable kidney, four complete recoveries, two deaths; four for neoplasms (one obscure, however), one death, three recoveries; finally, one pyonephrosis, perfectly successful.

Of the whole twenty-eight, there are fourteen recoveries and fourteen deaths; but, excluding the six for wrong diagnosis, there are still thirteen successful and nine fatal; two of the latter, however, were desperate and left uncompleted. The causes of death were—peritonitis, four (abdominal section in all); pyæmia, one; in one, cause not given, patient died sixty-five hours after; in one the cause is stated to have been unexplained by the autopsy, "the patient died within a week;" two died of shock ten hours after operation (both desperate cases). In all the successful cases recovery was complete, possible recurrence in two excepted (neoplasms). Of the thirteen recoveries nine were lumbar sections, four ventral; of the nine fatal, five were lumbar, four ventral. On the whole, a careful examination of all the records convinced the author that nephrectomy is not accompanied by any peculiar shock or risks apart from those attending most grave operations, and that it is well borne in many cases; that as an operation it has a most

useful future before it when we have learned to select proper cases and have better studied the operation itself.

As to the mode of procedure, he would, from experiment on the dead body and careful comparison of those operations already recorded, feel inclined for the present to adopt the following conclusions: The lumbar operation appears best suited for removal of healthy or comparatively healthy kidneys; also when there has been much perinephritic inflammation, old or recent; also for pyo- and hydronephrosis, and perhaps for the smaller new growths of the organ, especially if fixed. The ventral incision, appears, on the other hand, best suited for taking away movable kidneys, whether healthy or affected with neoplasms, especially if the latter be large; also for the ordinary cysts of the organ not fixed by inflammation. The difficulty, in the case of the neoplasmata, of removing the lymphatic glands in and about the pedicle of the kidney (which are known to be an early seat of recurrence) by the lumbar incision, would influence him much in favour of abdominal section, by which the root can be better reached.

The present case was as follows: An unmarried female, aged twenty-one, had had lumbar pain for eight months before admission into University College Hospital. Three months before admission a medical man diagnosed a movable kidney. She suffered much from this time onwards from intense pain, with frequent nausea, and even vomiting and hæmaturia, preventing all work for considerable periods. All this was aggravated from the time of admission. Diagnosis: movable kidney, and possible new growth in it; later on, after observation, movable kidney affected with encephaloid. The hæmaturia was almost constant and often profuse during her fifty days' stay in hospital. The attacks of pain were very severe and she was much weakened. On Dec. 22, 1879, an operation was performed like ovariotomy in almost every respect—strictly antiseptic. Little difficulty was experienced in the ascending mesocolon, though this had to be done with the utmost care, as the tumour was very soft in places; ureter was tied separately; pedicle in two portions by transfixion, with twisted silk. The operation was almost bloodless. Patient bore it well, and showed little shock. Twenty-four hours later she was as strong as before the operation; eight hours later she began to get weak, with hurried breathing, as in attacks before observed; diagnosis, possibly thrombosis. Death occurred at the end of the second day. Cause discovered to be thrombosis of pulmonary artery. The autopsy showed the abdominal cavity to be all that could be desired; repair already far advanced; no trace of cystitis; no evidence of embolus from renal vein, but large thrombus firm and light-coloured in right ventricle of heart and pulmonary artery. Small secondary deposits in lungs and lumbar lymphatic glands; suspicious specks in liver; other kidney healthy.

Mr. DAY narrated the history of a case successfully operated upon by Mr. Knowsley Thornton. The child was seven years of age, and came under notice in October last with a large cystic abdominal tumour, of five years' duration. Her general health had not suffered at all; the urine was scanty, but natural. Various opinions were given as to the nature of the case, and Mr. Thornton drew off six pints of fluid by the aspirator, the fluid having the characters of urine, and being slightly albuminous. The cyst gradually refilled, and on January 2d was removed by Mr. Thornton. The highest temperature after the operation was 101.6°. In reply to Dr. Southey, Dr. Day was unable to state whether urea was found in the fluid. (This case is reported in full in the current number of the *Medical News and Abstract.*)

Mr. KNOWSLEY THORNTON said that having made the diagnosis of renal cyst, he confirmed this by the aspirator, and then suggested the advisability of its removal. He came to the conclusion that in such a case as that abdominal

section was preferable to the lumbar operation, being strengthened in that view from finding in a case of pyonephrosis which he had incised about eighteen months previously, how difficult it would have been to secure the pedicle through the lumbar wound. One point laid stress on in the diagnosis of the case was the passage of the descending colon in front of the cyst, which, when distended, pushed between the layers of the mesocolon towards the median line of the abdomen. In operating he began his incision about one inch above and to the left of the umbilicus, and carried it down about an inch and a half below that part. He found afterwards that it would have been better to have made the incision about an inch higher. Owing to the child taking the anæsthetic badly, the vomiting and straining caused the intestines to appear at the wound, but this was the only difficulty encountered. After laying open the peritoneal capsule the cyst was shelled out, and its pedicle brought into view by drawing the cyst forwards. The renal artery and vein were first secured separately about an inch from the aorta, and then the whole pedicle embraced in a third ligature, as in Mr. Barker's case. The operation lasted nearly an hour and a half, and no shock followed. Immediately after the operation, temperature 97.8°, pulse 110, respiration 28. Much vomiting followed, and in the evening the temperature was 101.6°, pulse 150, respiration 32. For about the first twelve hours the urine passed was scanty, and contained much blood; but at 3 A. M. next day it was clear and deposited much urates. He found that the bloody urine did not decompose like that which contained no blood; for some days afterwards it was still free from odour and from bacteria. This seemed to indicate that the hæmaturia was really due to absorption of carbolic acid, and not to derangement of renal function from the extirpation of one organ. The child was up on the eleventh day after the operation, and had now just returned from a convalescent home. With regard to the general question of the method of operation, Mr. Thornton held that in cases of hydronephrosis abdominal section was to be preferred to the lumbar operation, as advised by Mr. Barker; but in cases where sinuses existed or adhesions, removal by abdominal section would be very difficult. The great advantage of abdominal section was that it allowed the operator to actually see the pedicle.

Mr. Clement Lucas considered extirpation of the kidney by either method to be perfectly justifiable; and it had been shown that one kidney could be removed without injurious effect. The choice of the operation must depend on the conditions of the case, *e. g.*, it would be impossible to remove a large mass through the loin. The chief dangers were secondary hemorrhage and thrombosis extending from the divided vessels. He inquired if Messrs. Barger and Thornton cut the ligatures on the pedicle close?

Mr. Barker and Mr. Thornton replied in the affirmative.

Mr. Lucas, continuing, said that if it were possible to see the renal artery, so as to grasp it well with forceps, then torsion should be employed. He could not understand why torsion was so little practised. At Guy's they did not know what secondary hemorrhage was since torsion had been employed, and it could be safely applied to arteries as large as the renal. Three weeks ago he had excised a kidney by the lumbar method. The organ had been suppurating for six years, and the abscess had been opened by Mr. Howse. The man recovered sufficiently to go to work, but suffered much pain. The fistula in the loin remained open, and pus was passed in the urine occasionally. Six months ago urine was passed through the loin. He was kept in the hospital for three months, and it was observed that when the sinus in the loin became blocked the quantity of urine passed from the bladder was not appreciably increased. This occurred several times and proved that the diseased kidney was not doing much

work. Extirpation was performed as follows: A vertical incision, as for colotomy, was made from the last rib to the iliac crest outside the quadratus. Great difficulty was experienced in detaching the organ owing to adhesions, and the incision was enlarged laterally to the extent of an inch and a half. The surface of the kidney was now exposed and ligatures placed round the pedicle, the vessels being tied separately from the ureter, and the organ removed. The case did well until a week ago, when hemorrhage (apparently started by accidental manipulation) set in, and recurred in spite of plugging. Mr. Lucas reopened the wound, which was lined by granulations, and passed a loop round the pedicle. This not controlling the hemorrhage, he, as a last resort, plugged the wound with two sponges soaked in a solution of perchloride of iron. There had been no recurrence of bleeding since then, and the patient was recovering from his anæmia. The sponges had not yet been removed.

Mr. SPENCER WELLS had seen Professor Simon, of Heidelberg, remove a kidney through the loin in a case of ureteral fistula following ovariotomy. The case was successful. Mr. Wells had repeated the operation on the dead subject, and found but little difficulty in it. Mr. Barker had included in his tables a case of his own, which occurred to him ten years ago. It was a case of a large cyst of doubtful origin. An exploratory incision gave exit to a large quantity of bloody fluid, and Mr. Wells was obliged to remove the cyst. It had a capacity of fourteen pints, and seemed to be connected with the uterus. The kidney, which was adherent to the cyst, but was free from disease, was removed with this, the renal artery being secured by torsion. The patient only survived three days, dying probably from septicæmia, for it was before he had adopted antiseptic measures in his cases. There was no uræmic symptom.

Mr. HAMILTON CARTWRIGHT instanced the following interesting fact as showing how much injury may be done to a kidney, and how little effect follow its removal. Some years ago, when in the Yang Tse River in China, he was shown by the doctor of an American vessel, also lying at anchor there, a specimen of a kidney. It had protruded from a wound in the loin, and had been dressed, according to Chinese fashion, with a mixture of bird's dung, saliva, etc.; and when the man was seen by the doctor the organ was in a state of putrefaction. Mr. Cartwright's acquaintance thereupon removed the mass, after which the patient, who had simply taken a pipe of opium during and after the operation, disappeared. He returned, however, in two or three weeks' time, and, as showing his appreciation of the services rendered him, brought with him another man suffering from cancer of the tongue.

Mr. BARKER recommends (*Lancet*, April 17, 1880) as an aid to diagnosis the insertion of a slender aspirator needle into the loin at a point midway between the crest of the ilium and last rib, directing the point towards the abdominal aspect of the spinal column, and a little upwards. If there be a stone in the kidney the point of the needle will be felt to grate upon it, and some pus may be withdrawn in the aspirator. If the tumour be a new growth or tuberculous, Mr. Barker thinks that enough debris will come away in the needle to enable a judgment to be formed of the nature of the growth.

In the *Lancet* for April 17, Dr. THOMAS SAVAGE, of Birmingham, reports a successful case of nephrotomy for hydronephrosis in a woman aged 46. The ventral incision was made, and a wire clamp used. The patient recovered, with a sinus from which a tea- to a tablespoonful of clear fluid was discharged daily.

Sulphide of Calcium in the Treatment of Suppurating Buboes.

Dr. FESSENDEN N. OTIS, Clinical Prof. of Venereal Diseases in College of Physicians and Surgeons, New York, endorses (*New York Med. Journal*, May,

1880) the claim made by Sydney Ringer (see *Monthly Abstract of Medical Science*, 1874, p. 195) of the value of sulphide of calcium in arresting processes of suppuration, and he has for the last five years habitually prescribed it in cases of threatened suppuration in phlegmonous swellings from various causes, and, as a rule, with very gratifying results. He administers it in doses of $\frac{1}{15}$ grain every two hours, or $\frac{1}{10}$ grain every hour, during the day and up to the time of retiring. He has found these small doses useful in arresting the progress of furuncular swellings and abscesses, and in preventing their occurrence when threatened. On the other hand, he has repeatedly tested the influence of this drug upon the suppurative processes in mucous membranes, as in gonorrhœa, gleet, leucorrhœa, etc., without being able to discover that it influenced or modified the suppurative process in such cases in the least degree.

Among the cases in Dr. Otis's private practice, where prompt arrest of suppuration was quickly followed by absorption of pus already formed and resolution of the tumour, and apparently from the use of the sulphide of calcium, were several inguinal buboes associated with chancroid. The simple fact that resolution occurred in these cases was (in accordance with the popular teaching) accepted as proof that the buboes were of sympathetic and not of chancroidal origin.

Authorities have long taught that, once the virus from a chancroid has been carried along a lymphatic vessel and deposited in the adjacent lymphatic gland, inflammation is at once set up in the substance of the gland. This, it is claimed, goes steadily on in spite of all and any treatment until an abscess is formed. This must, sooner or later, through advance of the suppurative agency or by surgical interference, result in an open ulcer, the pus of which will possess the same vicious character as the chancroid from which it was derived. This variety of bubo is known as the virulent or chancroidal bubo. The suppuration of such buboes has been considered *inevitable*, and all buboes not pursuing this course have been set down as not of true chancroidal but of simple or sympathetic origin. Inflammatory lymphatic enlargements associated with chancroid are very naturally dreaded as most likely to prove by results to be of chancroidal origin, and usually, after a few feeble attempts at treatment with a view to their resolution, glands so affected are encouraged to suppurate, and prompt incision and evacuation of pus are advised as soon as the slightest true fluctuation is recognized. If suppuration is indeed inevitable, undoubtedly it is wise to encourage it, to evacuate the virulent product at the earliest moment, and thus afford access for efficient treatment for the destruction of this new-formed chancroid. For this reason Dr. Otis has been an earnest advocate for an early incision into suppurating buboes associated with chancroid. His experience in the few cases above alluded to, however, made him incline to the belief that a thorough and extended trial of the calcium sulphide in cases of inflammatory buboes associated with chancroid might give such results as to make its use imperative in every such case.

In order to gain further light on this important matter, a systematic use of the calcium sulphide was made, in his service at Charity Hospital, in eighteen consecutive cases of inflammatory bubo occurring with, or as the immediate sequel of, well-pronounced chancroid. All the facts considered of importance were noted by himself and under his direction by Dr. Johnson, his House Surgeon.

Out of eighteen cases of inflammatory bubo presenting the rational evidences of chancroidal origin, and treated systematically by the use of small doses of the sulphide of calcium, resolution occurred in fifteen, and in only three cases was incision ultimately required.

If we apply to these cases the usual rule that chancroidal buboes always eventuate in chancroidal abscesses, always suppurate and require evacuation by natural means or surgical procedure, then we must hold that only three out of fifteen

cases of inflammatory buboes associated with chancroid were the result of transference of the suppurative process from the chancroid to the adjacent lymphatic gland. It is just possible, however, that the influence of the sulphide of calcium may, in arresting suppuration, extend to the true chancroidal bubo. The apparent successful use of this drug in the series of cases herewith presented at least suggests and invites a trial of its efficacy in all instances of threatened glandular suppuration, whether associated with chancroid or of purely sympathetic origin.

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Salicylate of Lime in Syphilitic Ulcers.

Dr. RODRIGUEZ VIFORCOS (*El Siglo Medico*, March, 1880) gives two cases of syphilitic ulcer, in which the beneficial effects of salicylate of lime were very marked. The first case was one of soft sores, five in number, occupying the sutures between the prepuce and the gland. These were dressed several times a day with a two per cent. solution of the salicylate of lime. Within eight days the surface of the ulcerated patches was perfectly clean, the character of the inflammation had changed, and in three days more (eleventh of treatment) healthy granulations had everywhere appeared. The second case was one of phagedenic ulceration of the skin of the penis, extending from the middle to the base of the organ. The parts were very much swollen, and the destructive action was evidently spreading. The author refrained from cauterization, believing that such a procedure tends, if anything, to increase the probability of necrosis, but had recourse to carbolic acid, alcohol, tincture of iodine, and various other medicaments. None of these, however, giving satisfactory results, he tried the same solution of salicylate of lime as in the preceding case. The effects were remarkable; the pain at once became less, and cicatrization, hitherto so sluggish, now set in with healthy vigour. Within thirty days of commencing the application of the salicylate, the ulcerated surface was completely healed over.—*Lond. Med. Record*, May 15, 1880.

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Removal of Effused Blood from Joints by Puncture.

The following questions, Prof. VOLKMANN points out (*Centralblatt für Chirurgie*, No. 10, 1880), are of considerable practical importance. Does the blood effused into an injured joint coagulate, or does it not? If it does coagulate, when and under what conditions does this coagulation take place? When and under what conditions is the blood absorbed? In a great number of cases of puncture of an injured joint, Volkmann always found the effused blood wholly, or almost wholly, fluid, when the trocar had been used in the course of the first three days. In one case on the sixth day, and in three cases after the eighth day, a considerable quantity of fluid blood, without any trace of clot, was drawn off. In most cases of puncture practised between the fourth and the eighth days, the great mass of the blood was found to be fluid, but was mixed with clots, some of which came away through the canula, whilst others remained within the joint. In one case of transverse fracture of the patella with wide separation of the fragments, and considerable distension of the synovial sac by blood, all the effused blood was found coagulated on the fifth day, so that not a drop could be withdrawn by aspiration, but only a few fragments of firm clots. The following case is quoted as being opposed to the view that coagulated blood within a joint, even when in considerable quantity, is rapidly absorbed. The patient was a man, aged forty, whose lower limb was amputated through the thigh, fourteen weeks after a compound and comminuted fracture of the tibia, associated with much contusion of the knee. The synovial sac of this articulation was found to be distended by a large mass of coagulated blood. The coagula were purely

adherent to the inner surface of the capsule. The joint did not contain any synovial fluid. Puncture of an injured joint was first recommended by Prof. Volkmann in 1861, as a plan of treatment to be carried out in cases of fracture, extending into a joint where the adaptation of the fragments is prevented in consequence of the amount of effused blood. In a case of transverse fracture of the patella with much effusion into the knee-joint, three ounces of blood mixed with synovial fluid were drawn off by an aspirating syringe on the second day. The fragments of the patella were then brought together by strapping, and a gypsum bandage was applied. At the end of the eighth week there was union which, if not osseous, was at least so strongly fibrous that no movement of the fragments on each other could be made out. Since the introduction of the antiseptic method of treating wounds, Prof. Volkmann has practised puncturing in every case of traumatic hæmarthrosis of the knee. In 1873, in addition to the case already mentioned of transverse fracture of the patella, there were three cases of contusion of the knee with intra-articular effusion of blood, in which this plan of treatment was carried out. In cases of extensive traumatic effusion of blood within the knee, if no such treatment be followed, the blood-clot is often removed very slowly, and the injury is followed after a time by hydrarthrosis, stretching of ligaments, and other serious changes. According to recent experiences of Prof. Volkmann, rapid organization of the effused and coagulated blood may cause ankylosis and total obliteration of the injured joint. This, however, rarely occurs, the usual result of traumatic hæmarthrosis being the deposit on the lower surface of the synovial membrane of an uniform layer of firm clot, through which the secretion of synovial fluid is altogether suppressed. On the death of a patient, eleven months after a transverse fracture of the patella through direct violence, and long after the fragments had united, partly by bone, the knee-joint was found to be ankylosed, and the articular cartilages to be bound together and to the synovial membrane by a continuous layer of dense connective tissue, which prevented the least movement. This layer of connective tissue was of a rust-brown colour, and, as did also the synovial membrane, presented deposits of granular blood-pigment.—*London Med. Record*, May 15, 1880.

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Secondary Sutural Union of the Radial Nerve.

Professor Von Langenbeck reports (*Berliner Klin. Wochenschrift*, *No.* 8, 1880), the following interesting case:—

The patient, a man of thirty-one, was injured in several places on September 5, 1879, by the fall of a ceiling in the house in which he was working. The right arm, which mainly interests us here, was bruised on the outer side, and there was some sloughing; an abscess formed and was opened, and a scar was left, corresponding exactly to the spot "where the radial nerve, after taking its course in an outward direction round the forearm, comes to the surface between the triceps and brachialis anticus muscles." At the same time a complete paralysis of the extensors of the hand and fingers, which dated from the time of the accident, persisted. The hand was pronated and hung loosely down. The fingers were slightly flexed and could not be extended, nor could the thumb be abducted. The corresponding muscles were unaffected either by the constant or induced current. The back of the hand and the arm were anæsthetic and somewhat œdematous. The diagnosis made was "breach of continuity in the right radial nerve as the result of the previous sloughing."

On November 25, 1879, an incision six centimetres long was made through the scar, and, after removing some very soft subcutaneous fat tissue, the divided ends of the radial nerve were found embedded in cicatricial tissue, about two centimetres apart, and *without* bulbous swelling. They were dissected out, a small

portion carefully removed with the scissors from each, and then united by a catgut suture carried through them with a fine round needle about one millimetre from their extremities. The tension required to bring them together was very great, and made Professor Langenbeck fear an unsuccessful result. The wound was dressed antiseptically, and the arm put on an obtuse-angled splint. On December 9 the wound had healed. On December 14 the induced current caused distinct contraction of the extensors of the hand and fingers, and there was a slight power of voluntary movement. On December 20 the latter was well marked; and on January 14, 1880, under daily treatment with the induced current, the patient could extend his fingers completely, and raise the hand to a level with the forearm, but not further.

In his remarks on this interesting case, Professor Langenbeck observed that, owing partly to the great tension of the nerve-ends, and partly to the fact that no nerve-tissue could be found in the portions removed by the scissors, he had very little hope that continuity would be restored. Gluck, however ("Experimentelles sur Frage Nervennaht und der Nervenregeneration"—*Virchow's Archiv*, Bd. 78, 1878), has shown that the divided ends of a nerve unite by means of an intermediate substance consisting of granulation tissue in which spindle-cells develop and send out processes which unite the axis-cylinders of the nerve-ends together, and finally become converted into true nerve-fibrils. Probably some such intermediate substance was formed in Professor Langenbeck's case. The radial nerve has been sutured in two other cases: by Létiévant unsuccessfully, and by Esmarch (sixteen months after the injury) with almost perfect restoration of the functions and sensibility of the hand. On the whole, Professor Langenbeck does not consider the results of operation for nerve suture hitherto very successful. In all the published cases except the present there were severe pains in the course of the sutured nerves, and the wound did not heal by first intention, as here, or went through a long period of suppuration. Most of the former cases were sutured with silver wire or silk. Langenbeck strongly recommends catgut: it irritates less, can remain *in situ* permanently, and can be carried through the nerve-ends themselves. The absence of bulbous swelling in the divided nerve-ends has been already noticed. Professor Langenbeck explains this deviation from the rule in his case by the radial nerve having probably suffered a slow, and not a sudden, process of division during the sloughing of the bruised tissue of the arm. His case is further peculiar in the fact that the motor or centrifugal functions of the nerve were restored before the centripetal or sensory. The back of the hand remained anæsthetic when the extensor movements of the hand and fingers were completely restored.—*Med. Times and Gaz.*, May 29, 1880.

OPHTHALMOLOGY AND OTOLOGY.

Diabetic Hypermetropia.

The ocular complications of diabetes are well known, and diabetic cataract, retinal hemorrhages, optic neuritis, and paralysis both of the intrinsic and external muscles of the eye are often met with. Dr. LANDOLT contributes an article to *El Siglo Medico*, of Madrid, and calls attention to a symptom which has hitherto attracted but little attention. A woman, aged sixty-one, consulted him with reference to her sight. Long vision had always been good, and she had also seen well at a short distance with the aid of glasses, which, however, had now become inefficient. Upon examination he found that she had a hyper-

metropia of 1.25 dioptrics (= old No. 30), visual acuity 0.5, presbyopia 5 dioptrics (old 8). With these glasses she saw well, so that the change of the sight depended upon a change in the refraction, rather than upon an alteration of the visual acuity. This change had occurred after a fall six months before, and in consequence of which she had suffered from pains in the back and hips, as well as from glycosuria. At the time of consultation there were 229.4 grammes of sugar in 2630 cubic centimetres of urine analyzed. The specific gravity was 1040. Fifteen days later the hypermetropia was only 0.75 dioptrics (old 50), and after four months 0.25 (old 156). At the end of five months it had entirely disappeared. The patient had become emmetropic, as before, and had returned to her old glasses. Coincidently with this increase of the refraction the quantity of sugar in the urine diminished, and when the hypermetropia had become 0.75 dioptrics it had disappeared altogether. The author attributes this diminution of refraction (hypermetropia) to the infiltration of sugar into the vitreous humor, in consequence of which the index of refraction is increased, whilst the general refraction of the eye is lessened.—*Lancet*, April 17, 1880.

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A Case of Gonorrhœal Ophthalmia, with some novel suggestions as to Treatment.

Mr. George Critchett, Consulting Surgeon to the Royal London Ophthalmic Hospital, in a communication to the *Lancet* (April 3, 1880), says:—

As a general rule I have been unwilling to encumber medical literature with isolated cases, but I am disposed to think that exceptions may occasionally occur in which, either from extreme rarity or from the initiation of some new method of treatment, or, at any rate, a method very rarely employed and but little known, some fresh starting point may be established. Acting on this principle, and influenced by these motives, I am induced to bring the following case before the notice of the profession:—

Louisa C——, aged two and a half years, was brought to me at the Middlesex Hospital on the 15th of May, 1878. Her left eye presented all the appearances of acute gonorrhœal ophthalmia, and the collateral circumstances confirmed this diagnosis, as the child had a profuse yellow discharge from the vagina, with considerable swelling and irritation of the mucous canal. The lids were of a bright red colour and much swollen, and so densely infiltrated that even when the child was placed under the influence of an anæsthetic it was found impossible to separate them so as to ascertain the condition of the cornea. Yellow, and rather thick matter was exuding from between the lids.

Judging from past experience, seeing the extreme acuteness and severity of the symptoms, the difficulty in separating the lids or exposing the cornea, and the impossibility of getting any solution into contact with the conjunctival surface, I relinquished all hope of saving the sight. I have never in the course of my experience known such a condition eventuate otherwise than in the total destruction of the eye. Under these circumstances I determined to adopt a somewhat heroic and novel proceeding, and one that has not, I believe, been published. I passed a small silver director under the upper lid as far as the edge of the orbit, against which I kept it pressed; and then, with a small, sharp-pointed bistoury, I completely divided the lid perpendicularly as far as the margin of the eyebrow. In order more completely to uncover the cornea, I separated the two angles of the divided tarsus, and fixed them with fine sutures to the skin of the eyebrow. The cornea looked steamy, but not ulcerated, and was buried in chemosed conjunctiva. The immediate effect of this proceeding was to diminish the redness and swelling of the lids and conjunctival membrane and completely to expose the surface.

In the subsequent treatment of the case I was materially assisted by the house-surgeon, Mr. Dixon, who carried out my directions with great care, skill, and assiduity. A solution of nitrate of silver—thirty grains to one ounce—was painted over the entire surface of the conjunctiva three times daily, the eye was frequently cleansed and syringed with a solution of alum—ten grains to one ounce,—and a piece of linen moistened in the solution was kept constantly applied. This plan was continued, with gradual abatement of the symptoms, for a month; a weaker solution was then substituted, and at the end of six weeks from the commencement of the treatment the eye had recovered with a perfectly bright healthy cornea.

At the termination of another fortnight the child was again placed under the influence of an anæsthetic, when I pared the edges of the divided lids and brought them together with fine sutures. Good union occurred, the deformity is very slight, and the lid perfectly performs its function.

I may add that during the early part of the treatment the other eye was kept carefully closed with strapping so as to prevent any risk of inoculation.

To some it may seem that this rather novel proceeding was of too heroic and severe a character, but it at least had the merit of success. Every case of gonorrhœal ophthalmia, the result of direct contagion, that has come either under my care or my observation has been so uniformly attended with loss of the affected eye that I should certainly adopt a similar proceeding on any future occasion, and I beg to commend it to the attention of the profession. It seems to fulfil every indication: it relieves the immediate tension, and the strangulation with which the cornea is threatened; it permits the free escape of the matter, and enables the surgeon to make a thorough use of caustic and astringent remedies: while the slight subsequent scar on the lid is a small price to pay for a rescued eye.

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Antiseptic Dressings in Ocular Surgery.

LUCAS-CHAMPIONNIÈRE (*Recueil d'Ophthalmologie*, April, 1880) sums up an essay on this subject by the following general conclusions. All antiseptic precautionary measures, apart from the immediate operation, such as cleansing of instruments, hands, etc., should be carried out by means of the stronger solutions of carbolic acid; but these are not suitable in operations upon the transparent parts of the eye. A strong solution of boracic acid is, however, generally well borne, as also pulverization, provided the spray apparatus be held at a sufficient distance. As a means of occlusion, the author prefers lint soaked in boracic acid in preference to carbolized gauze. Operations on the conjunctiva necessitate the same precautions, so far as concerns not irritating the eye by a strong antiseptic. If, however, the eye be destroyed, as in most of the cases which call for enucleation, or if the operation be a plastic one, carbolic acid is, perhaps, the most preferable disinfectant. The author, after enucleation, is accustomed to wash out the orbital cavity freely with a strong solution of the acid, and then to apply borated dressings over the lids, but nothing between them. For small wounds on the eyelids or ciliary margins, he advocates the use of borated ointment, spread on lint, the whole covered either with some impenetrable material, or with a layer of lint soaked in boracic acid, according as a moist or dry dressing is desired. On the whole, vaseline and boracic acid are the antiseptics of most use in ocular surgery.—*London Medical Record*, May 15, 1880.

MIDWIFERY AND GYNÆCOLOGY.

On the Treatment of Pelvic Suppuration by Abdominal Section and Drainage.

At a late meeting of the Royal Medical and Chirurgical Society (*British Med. Journal*, May 15, 1880), Mr. LAWSON TAIT advocated the principle of opening and draining the various conditions of suppuration classed as "pelvic abscess." He pointed out, and quoted Dr. West in support, that, in very many of these cases, the abscess opened into the rectum or other part of the intestine, into the bladder, or amongst the muscles of the anterior abdominal wall. When such openings were established, either death occurred or recovery was extremely protracted. Even when the abscess opened into the vagina or could be tapped from that canal, the recovery was frequently prolonged to an extent not commensurate with the size of the abscess. The author narrated six cases of pelvic origin, all of which seemed to have originated in extraperitoneal hæmatoceles. In none of them would vaginal tapping have been effectual in properly emptying the abscess of the *débris* of the clots. They were opened from above, the opening into the abscess-cavity being carefully stitched to the opening in the abdominal wall, save in one case where an already made adhesion rendered this part of the operation unnecessary. Wide glass drainage-tubes were then inserted, and were changed for smaller ones, and these again for wire or soft India-rubber tubes. The abscesses were closed, and the patients restored to health in about thirty days; they all made rapid and complete recoveries. Mr. Tait's general conclusion from these cases was, that the opening of such abscesses by abdominal section was neither difficult nor dangerous; that recovery was made in this way more certain and rapid than in any other. In future, he would always advise an exploratory incision in cases where he was satisfied there was an abscess, but where he could not reach it or empty it satisfactorily from below.

Mr. KNOWSLEY THORNTON said that the operation described by Mr. Tait was a great advance in surgery. Cases of pelvic suppuration had long been very unsatisfactory. He had treated two cases on the plan recommended by Mr. Tait. While many cases in which there was an opening through the vagina did badly, there was no doubt that some did well; but he thought that the abdominal section was to be preferred, especially if it were done antiseptically.

Mr. SPENCER WELLS thought that, in most cases, it was unnecessary to open the peritoneal cavity. The blood, pus, or serum could escape through an opening made through the vagina with a trocar; it should be kept free by means of a piece of wire, and an antiseptic solution, as of iodine or carbolic acid, should be injected. Mr. LAWSON TAIT said that Lister's method was followed in the first four cases, not in the others. The glass tubes used were those recommended by Kœberlé, varying in length from six to two inches, and from an inch to a quarter of an inch in diameter. No special antiseptic measures were used after the operations. In the sixth case, the patient had symptoms of septic poison before the operation; when the opening was made, these ceased, although no antiseptic was used. There was no intestinal adhesion in any of the cases, nor any difficulty about the action of the bowels. The incision was about the same length as in ovariotomy; the peritoneum was opened in five of the cases. There was no difficulty in stitching the wall of the abscess to the abdominal wall. Cases might be operated on through the vagina, but their progress was very tedious, and there was a probability of missing the abscess in tapping *per vaginam*. For the present, he would limit the abdominal operation to cases in which this probability existed.

Case of Extra-Uterine Gestation Treated by Abdominal Section.

At a late meeting of the Royal Medical and Chirurgical Society (*British Med. Journal*, May 15, 1880), Mr. LAWSON TAIT reported a third case which differed from the two previously read before the Society, in that the operation was performed before the death of the child, whose life was saved, but the mother succumbed to the operation.

Mrs. S., aged 33, had been married fourteen years and had had six children. Since her last menstruation, in May, 1879, she had been in constant pain, of which a severe attack occurred in July. In October she became satisfied she was pregnant; and Mr. Lattey, under whose care she was, suspecting the nature of the case, asked Mr. Tait to see her. A large abdominal swelling was evidently a pregnancy, and to the left of the umbilicus was a prominent mass, which, from its rhythmic contraction, was clearly the uterus, and was attached to the larger mass behind it: The head of the child was detected between the rectum and vagina. The pain becoming agonizing, and being unrelieved by opiates, an operation was determined on. Ether was administered on the morning of January 31st; and, on making the median incision, the empty uterus was found, and the cyst, which was the right broad ligament, was opened and the child removed without difficulty; the edges of the opening in the cyst were then secured to those of the parietal wound, leaving an opening for the discharge of the placenta, and the peritoneal cavity was closed. The child was at first profoundly narcotized, but was now, three months afterwards, thriving and well. The death of the mother, which occurred on the fourth day, seemed to be from protracted shock.

At the *post-mortem* examination, there were found some morbid appearances in the liver, and *ante-mortem* clots in the heart, but no peritonitis. The cyst proved to be the broad ligament, as diagnosed, and there was a deciduous lining in the uterus in process of separation. The Fallopian tube had been ruptured at its lower aspect, the ovum thus escaping into the tissue of the broad ligament; and the case confirmed the author's opinion that all extra-uterine pregnancies were originally tubal, that the tube burst between eight and twelve weeks, and where this did not produce death, an extra-uterine pregnancy was completed. The unfavourable result to the mother was due to the delay in the operation; but the case was of interest from the saving of the child. The child might have been removed by vaginal section, but the presence of large venous sinuses in every direction made it likely that any injury to one of them would be fatal; and in vaginal section it was impossible to see what to avoid.

Mr. SPENCER WELLS did not think it necessary to assume that rupture of the Fallopian tube occurred in all cases of extra-uterine pregnancy. An ovum might escape at the end of the tube and lodge anywhere. In a case of combined intra-uterine and extra-uterine pregnancy which he had examined, there was no rupture of the tube.

Dr. JOHN HARLEY suggested operation for the removal of the fœtus as soon as a correct diagnosis could be made. In a case under his care at St. Thomas's Hospital, a woman had a painful tumour in the side of the abdomen. He at first thought it to be malignant, especially as it increased in size. Soon, however, he found it to be an extra-uterine pregnancy. The woman was transferred to the obstetric wards, and was not operated on till pregnancy was far advanced. The children lived for two or three months, but the woman died.

Mr. TAIT said that the placenta had been left in the wound, as first recommended by Kœberlé. In such cases, it was gradually removed, and the wound healed from the bottom. The pathology of extra-uterine pregnancy was too extensive to discuss at present; but he had treated of the subject fully elsewhere,

and he adhered to his belief that in all the cases where examination had been made there was rupture of the Fallopian tube.

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Case of Extra-Uterine Fœtation about the Seventh Month of Pregnancy; Sudden Urgent Symptoms; Removal of Fœtus by Abdominal Section; Death.

At a late meeting of the Obstetrical Society of London Dr. Braxton Hicks narrated the following case: The patient, aged twenty-nine, married ten years, had had two children, one seven years, the other four years since; no miscarriages. In April, 1879, she was taken with severe vomiting and abdominal pain, for which she was kept in bed a month. After getting up, she said that her womb came down. In July she was admitted into Guy's Hospital under Dr. Galabin, and then thought herself about six months pregnant. Only the fact of pregnancy, together with the swelling behind the cervix, was then made out, and she shortly left the hospital. In the first week of August she was re-admitted under the author, in the absence of his colleague. A tense enlargement then extended on the right side, three inches from the middle line, up as high as the umbilicus, whence it rose nearly to the left ribs, towards the flank, and extended downwards, filling the whole left hypogastric region. This evidently contained a living fœtus. A so-called "placental bruit" was heard over the centre of the abdomen, below the umbilicus. The cervix protruded through the vulva, the external os being patulous, so that the finger could reach the internal os, which was closed. The sound could not be carried into the uterus beyond the unimpregnated length. For greater assurance he had a sponge-tent introduced into the uterus, but nothing was found within but some fragments of decidua. At the end of a week she was suddenly taken with increased pain and distension of lower abdomen, shortly followed by collapse and pallor, pulse rising to 140, thready, temperature normal. She said that, while sitting by the side of the bed, she felt something give way in her lower abdomen, upon which the fœtus kicked violently, and then she became faint, and shortly after the movements ceased entirely. Three hours later the author found her in great distress from the tension, saw that evidently blood had been effused internally, and decided to operate, as the only chance for her life. This was done under carbolic spray, the incision being made in the median line, which had now become the most prominent part. A cavity was opened, containing a large quantity of dark, watery blood, which had evidently been effused within the placental area, and had been the cause of the symptoms. After its escape, the chorion was ruptured, and the lifeless fœtus, about the size of a large six months normal fœtus, extracted. Not much more blood flowed, and the wound was closed except an opening an inch and a half long. The patient, however, began to show signs of sinking, and died shortly after. At the *autopsy* it was found that the placenta extended up the abdominal wall in front almost to the umbilicus, and was not attached to uterus or bladder. The sac was adherent in all directions to intestines and other parts. Its lowest portion was attached in front of the uterus and behind the bladder. On the anterior surface of the uterus was a pedunculated fibroid as large as a walnut. The right Fallopian tube, firmly bound by adhesions, crossed the anterior surface of the uterus, and was attached to the lower surface of the fibroid, terminating in some loose tissue under the placenta. The right ovary was adherent to the right side of the amnial sac, and contained a large corpus luteum. The author remarked—(1) that the case was the analogue of concealed accidental hemorrhage in normal pregnancy; (2) that it was a clear case of true ventral pregnancy; and (3) he asked the opinion of the Society how the hemorrhage should be stopped if the operation were performed during active fœtal life, and the placenta found

situated as in this instance. He thought that carbolized sutures might be kept within for a time, and a compress maintained, since rigid antiseptic treatment would be impossible.

Dr. WILTSHIRE thought that there was no doubt that abdominal pregnancy did occur, and instanced a case of Koeberle's in which, after ablation of an inverted uterus, pregnancy ensued by means of a fistulous opening at the top of the vagina: also one in which the roof of the vagina was ruptured by forcible coitus. He thought that, in the present case, as an exception to the general rule, it might have been preferable to remove the placenta.

Dr. ROUTH thought that, if the position of the placenta had been made out by auscultation, the incision might have been made away from the median line, and wounding the placenta avoided. He also asked why Dr. Hicks did not, in preference to performing gastrotomy at all, aspirate the sac, or kill the fœtus by injecting morphia into the amnial cavity. The separation of the placenta seemed to have been caused by the fœtal movements.

Dr. GERVIS mentioned a case in which he had performed primary gastrotomy for extra-uterine fœtation. Not much difficulty was met with, and but trifling hemorrhage, the position of the placenta being mostly in the pelvis; but the patient died in about three days, as the result of a continuous hemorrhagic loss through the drainage-tube. The autopsy showed no sign of peritonitis, but separation of the placental margins. Could any treatment diminish this danger?

Dr. PLAYFAIR was surprised to hear Dr. Hicks say that perfect antiseptic treatment was impossible, and thought that the chief hope of progress in such cases lay in carrying it out completely, however difficult that might be.

Dr. J. WILLIAMS thought that the insertion of a tent into the cervix was superfluous for diagnosis, and that it possibly had something to do with the sudden accession of severe symptoms.

Dr. EDIS called attention to the monograph of the late Dr. Parry of Philadelphia, who was led by his statistics to condemn the puncture of the cyst, and to recommend either removing the fœtus entire or allowing the cyst to remain uninjured.

Dr. BARNES was inclined to think that the present might be reckoned among a few exceptional cases in which removal of the placenta might be justifiable, the hemorrhage being afterwards stopped by compressing the abdominal walls together.

Dr. BRAXTON HICKS said that most of the speakers had mistaken the state of the case. Urgent symptoms suddenly came on while he was waiting for a short time to consider the best line of treatment. The tension was then so great as to obliterate the previous outline, but he did not think that the position of a *souffle* would always absolutely determine the site of the placenta. He differed from Dr. Routh, and regarded the violent saltation of the fœtus as evidence of its impending death from asphyxia. No great amount of recent blood was lost during the operation, but the question he had asked was: What should be the treatment if the placenta was cut, the fœtus being still alive? He could not agree with Dr. Barnes, that the placenta might be removed without too great risk of hemorrhage. In answer to Dr. Playfair, he thought that it would be extremely difficult to carry out the antiseptic treatment perfectly, though it might be possible under advantageous circumstances.—*Med. Times and Gaz.*, May 22, 1880.

MEDICAL JURISPRUDENCE AND TOXICOLOGY.

Carbolic Acid Poisoning.

A sufficiently large number of cases have now been collected to establish beyond doubt the toxic influence which carbolic acid, used antiseptically, can at times exert. So long ago as 1875, Tardieu called attention to this important fact, and gave particulars of fifteen cases which up to that date had come under the notice of either himself or other observers. Since then the number of recorded cases has so largely increased that their consideration from a surgical point of view has become of the utmost importance.

Poisoning by carbolic acid applied externally may occur under two different forms. It may be sudden and without apparent cause, the patient sinking rapidly after the application of the dressings. KUSTER of Berlin has related five such cases, in one of which, however, recovery eventually took place. He opines that many so-called cases of death from shock or collapse after operations are really due to neither more nor less than poisoning from the carbolic acid employed. The second form is the more insidious and the more common, and therefore possesses greater interest for the surgeon. In it the symptoms show themselves only after a certain interval of time has elapsed. A patient after operation will perhaps steadily improve for some days or weeks. He will then become restless, his temperature will rise three or four degrees above normal, symptoms apparently of incipient septicæmia will develop themselves, and will in all probability be met by a more vigorous employment of antiseptic methods. The condition of the patient, however, becomes daily worse. Nausea, loss of appetite, giddiness, clonic spasms, great prostration, with coma, and even death, may close, and indeed have already too often closed, the scene. In many of these cases, there is no room for doubt as to the cause. It has been shown many times that, where recovery has taken place, the improvement in the symptoms has coincided in the most marked manner with the cessation of the use of carbolized dressings. On the other hand, it has been noticed that the symptoms have always become aggravated shortly after the dressings have been applied. The temperature has risen, and the patient has become more restless and uncomfortable, just at the very time when an opposite result might fairly have been looked for.

The most reliable symptom of carbolic acid poisoning, and one which is present in the vast majority of cases, is found in the condition of the urine. According to BAUMANN (*Pflüger's Archiv*, Band xiii.), we have in the reactions of this fluid a certain means of diagnosing not merely the fact, but the actual degree in which the intoxication is present. The urine often assumes a dusky hue, becoming almost black, and exhaling a peculiar odour, which is not, however, that of carbolic acid. The chemical tests are, however, more important and reliable than the physical appearances, which, indeed, may be at times absent. The most reliable test, and the one most readily applied, is that of Sonnenburg. It is founded on an estimation of the quantity of normal sulphates present in any given specimen. The sample of urine to be examined is first acidulated with strong acetic acid, and baric chloride is then added in excess. A copious precipitate, consisting mainly of baric sulphate, is at once formed if the urine be healthy. From the copiousness or otherwise of this precipitate, any albumen that may be present having first of all been separated, the degree of intoxication may be estimated. If acute or in an advanced stage, scarcely any precipitate will be deposited, the normal sulphates having undergone decomposition, and become soluble sulpho-carbolates.

As regards the treatment of carbolic acid poisoning, the first and most obvious

step is to at once cease use of the acid. This in most cases will be sufficient to effect a cure, if the mischief have not advanced too far. It is, however, by no means necessary to leave off antiseptic treatment. It will be enough if some other disinfectant, such as salicylic acid or thymol, be substituted for the one hitherto used. Strongly oxidizing agents, such as potassic permanganate and calcic chlorate, would probably lessen the activity of the poison, but as a rule they are inadmissible as antidotes, from the effect they themselves exert on the mucous membrane of the stomach. The latest researches of Baumann in this direction give, however, some valuable results. He has succeeded in showing that sodic sulphate forms with carbolic acid, within the body, soluble and innocuous sulpho-carbolates. Hence Glauber's salt, or other soluble sulphate, would appear to be the direct chemical antidote to carbolic acid present by absorption or otherwise in the blood or tissues.

In the present state of knowledge on the subject, little more can be recommended than increased care in the use of what is undoubtedly a valuable and active medicament. It need scarcely be remarked that the chief danger of absorption exists in the case of large cavities, such as those remaining after the evacuation of ulcers, or where disinfectants have been injected into the larger joints, the pleura, or the uterus. It is probable that strong solutions of carbolic acid are less dangerous than weak ones, for, by coagulating at once the albumen of the tissues, they render further absorption impossible. Children and feeble persons are more susceptible to the toxic effects of the acid than those of a more robust type. The main point is to watch every case carefully, and on the slightest sign of any rise in temperature, or any increased restlessness and discomfort after the applications of the dressings, to have recourse to the barium test. It should not be forgotten that the mere quantity of acid used affords no criterion as to its probable effects. These will vary in each case with the age, the state of health, and the idiosyncrasy of each individual.—*London Med. Record*, May 15, 1880.

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On the Toxic Action of Salicylate of Soda.

This subject, though manifestly of extreme importance, has attracted comparatively little attention in England. On the Continent, however, several observers have lately recorded well-marked and unmistakable cases of subacute poisoning by salicylate of soda. Thus, in a record of 250 cases, CATTI (*Gazetta degli Ospitali*, Feb. 29, 1880) witnessed unpleasant and even alarming symptoms in four. In one, the drug administered in doses of twelve grains every four hours, during a period of ten hours, caused drowsiness, deafness, and complete amaurosis; in another, subacute delirium; in a third, severe gastralgia; and in a fourth, well-marked dyspnœa. PETERSEN (*Deut. Med. Woch.*, Nos. 2, 3, 1877) mentions a case in which twenty-two grammes, administered in the space of six hours, induced disturbances both of respiration and circulation. But GUBLER (*Journal de Pharmacie*, June, 1879) goes further than either of these observers in his estimate of the toxic properties of both salicylic acid and its soda salt. According to him, they at times produce effects not inferior to those of an irritant poison. Among such he enumerates severe colic, copious diarrhœa, cyanosis, and collapse, with eventually ulceration of portions of the digestive tract. On the other hand, a long array of names may be quoted in support of conclusions diametrically opposed to those of Petersen and Gubler. In this case, however, negative evidence is of comparatively little importance. The question at issue is not the possibility, but rather the frequency, or otherwise of salicylic intoxication. Of the fact of such having occurred, there is unfortunately no room for doubt; both clinical observation and physiological experiments having thoroughly established it.

CHIRONE and PETRUCCI (*Commentario Clinico di Pisa*, January and February, 1878) have demonstrated that salicylate of soda administered to animals first increases and then diminishes the frequency of the respirations, while Buss and Kœler have shown that dogs and rabbits poisoned by it have died with the symptoms and *post-mortem* signs of asphyxia. Considering the very extensive use of salicylate of soda as a therapeutic agent, it is important to have some ready means of watching its action on the system. Administered in medicinal doses, it can generally be readily detected in the urine within two hours of its ingestion. The best and most sensitive test of its presence is a few drops of perchloride of iron added to the urine in a test-tube. If salicylic acid be present, a bright violet colour, due to the formation of salicyluric acid, will at once be struck. This reaction is extremely delicate, and may be relied on if one part in a million of the acid exists in the sample of urine. It being known that almost if not all the acid ingested is eliminated by the kidneys, its presence will be a more or less satisfactory proof that these organs are physiologically sound. Should it not appear, however, it is evidently either accumulating in the system, or is undergoing some abnormal decomposition by which its chemical characteristics are being essentially altered. Seeing, therefore, that the toxic effects of salicylate of soda may manifest themselves at any moment, and in any case, some general rules as regards its administration seem to be called for. Judging from their known physiological action, all salicylates should be given with considerable caution in cases either of phthisis or of renal disease. Their employment should at once be stopped, or at least very carefully watched, whenever the characteristic appearances in the urine cannot readily be detected within two hours after ingestion of the medicine. The possibility of idiosyncrasy in certain individuals should always be borne in mind, together with the fact that salicylic acid itself is not infrequently adulterated with carbolic acid. The importance of this latter fact is self-evident. After all, however, very little is as yet accurately known as regards the indications either for or against the use of salicylic acid and its salts. In such circumstances, therefore, the practitioner can do little more than study carefully and intelligently each case on its own merits, bearing in mind that, so far as at present observed, all untoward symptoms have quickly passed off, without having left any permanent ill effects.—*London Med. Record*, May 15, 1880.

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Inhalations of Oxygen in Poisoning by Laudanum.

At a late meeting of the Société de Thérapeutique (*Bull. Gén. de Thérapeutique*, Feb. 15, 1880), M. CREQUY reported that he had used with success, in a case of poisoning by laudanum, inhalations of oxygen. The case was a child of four months attacked with diarrhœa. It had been given by mistake a coffee-spoonful of a laudanum potion, after the absorption of which the child fell into a state of deep narcotism; death seemed to be imminent, when M. Crequy resorted to the use of inhalations of oxygen; improvement was rapid, but it seemed to cease as soon as the inhalations were abandoned. The cure was complete at the end of twenty-four hours.

He adds to this case one he observed three years ago. A woman, asphyxiated by coal-gas, was cured by the same treatment, but he adds that this treatment should be prolonged beyond the apparent cure, otherwise the patient would be exposed to the return of toxic symptoms.

M. LIMOUSIN recalls the fact that M. Constantin Paul, twelve years ago, reported a case like the one M. Crequy has just described; it occurred in a woman poisoned by extract of opium.

JEFFERSON MEDICAL COLLEGE,

PHILADELPHIA.

THE Fifty-sixth Session of the Jefferson Medical College will begin on Monday, October 4th, 1880, and will continue until the first of March, 1881. Preliminary Lectures will be held from Monday, 6th of September.

PROFESSORS.

JOSEPH PANCOAST, M.D.,
General, Descriptive, and Surgical Anatomy (Emeritus).

S. D. GROSS, M.D., LL.D., D.C.L. Oxon.,
Institutes and Practice of Surgery.

ELLERSLIE WALLACE, M.D.,
Obstetrics and Diseases of Women and Children.

J. M. DA COSTA, M.D.,
Practice of Medicine.

WM. H. PANCOAST, M.D.,
General, Descriptive, and Surgical Anatomy.

ROBERT E. ROGERS, M.D.,
Medical Chemistry and Toxicology.

ROBERTS BARTHOLOW, M.D.,
Materia Medica and General Therapeutics.

HENRY C. CHAPMAN, M.D.,
Institutes of Medicine and Medical Jurisprudence.

CLINICAL INSTRUCTION is given *daily* at the HOSPITAL OF THE JEFFERSON MEDICAL COLLEGE throughout the year by Members of the Faculty, and by the Hospital Staff, which is constituted as follows:—

Surgeons.

JOHN H. BRINTON, M.D.,
S. W. GROSS, M.D.,
R. J. LEVIS, M.D.

Ophthalmic Surgeon.

PROF. WILLIAM THOMSON, M.D.

Aural Surgeon.

L. TURNBULL, M.D.

Physicians.

J. SOLIS-COHEN, M.D.,
JAMES C. WILSON, M.D.,
OLIVER P. REX, M.D.,
W. W. VANVALZAH, M.D.

Gynæcologists.

F. H. GETCHELL, M.D.,
J. EWING MEARS, M.D.

Pathologist.

MORRIS LONGSTRETH, M.D.

A SUMMER COURSE of Lectures is given, beginning on the fourth Monday in March, 1881, and extending through the months of April and May, and to the middle of June. There is no additional charge for this Course to matriculates of the College, except a registration fee of five dollars; non-matriculates pay forty dollars, thirty-five of which, however, are credited on the amount of fees paid for the ensuing Winter Course.

FEES.

Matriculation Fee (paid once)	$5 00	Practical Anatomy	$10 00
Ticket of each Professor (7) $20	140 00	Graduation Fee	30 00

The Annual Announcement, giving full particulars, will be sent on application to

ELLERSLIE WALLACE, Dean.

Graduates who may see this notice will confer a great favor by sending to the Dean a postal card with the correct names and residences of themselves, and of other graduates in their vicinity, to whom announcements may be sent.

ALUMNI PRIZE OF FIVE HUNDRED DOLLARS.

The Cartwright Prize of the Alumni Association of the College of Physicians and Surgeons, New York, which amounts to $500, will be awarded, subject to the following conditions, to the best essay on some subject in medicine or surgery:—

1. The prize is open to the competition only of Alumni of the College.
2. The subject is left to the option of the contributor.
3. The essay must present sufficient original experimental or clinical observation to make it a useful contribution to medical knowledge.
4. The essay, designated by a motto, must be sent to a member of the Committee on Prize Essays, accompanied by a sealed envelope inscribed with the motto, and containing the name and address of the author, on or before February 1st, 1881.

Committee { A. H. BUCK, M.D., 52 East 31st Street.
J. E. JANVRIN, M.D., 120 Madison Avenue.
W. T. BULL, M.D., 33 West 33d Street.

The Alumni Prize, also amounting to $500, will be awarded in 1882, subject to the same conditions.

UNIVERSITY OF PENNSYLVANIA—MEDICAL DEPARTMENT.

Thirty-Sixth Street and Woodland Avenue (Darby Road), Philadelphia.

One Hundred and Fifteenth Annual Session, 1880-81.

PROFESSORS.

CHARLES J. STILLÉ, LL.D., Provost.
HENRY H. SMITH, M.D., Emeritus Professor of Surgery.

JOSEPH LEIDY, M.D., LL.D., Professor of Anatomy.
RICHARD A. F. PENROSE, M.D., LL.D., Professor of Obstetrics and Diseases of Women and Children.
ALFRED STILLÉ, M.D., LL.D., Professor of Theory and Practice of Medicine, and Clinical Medicine.
D. HAYES AGNEW, M.D., LL.D., John Rhea Barton Professor of Surgery and Clinical Surgery.
WILLIAM PEPPER, M.D., Professor of Clinical Medicine.
WILLIAM GOODELL, M.D., Professor of Clinical Gynæcology.
JAMES TYSON, M.D., Professor of General Pathology and Morbid Anatomy.
HORATIO C. WOOD, M.D., Professor of Materia Medica, General Therapeutics, and Pharmacy.
THEODORE G. WORMLEY, M.D., LL.D., Professor of Chemistry.
JOHN ASHHURST, Jr., M.D., Professor of Clinical Surgery.
HARRISON ALLEN, M.D., Professor of Physiology.
WILLIAM F. NORRIS, M.D., Clinical Professor of Diseases of the Eye.
GEORGE STRAWBRIDGE, M.D., Clinical Professor of Diseases of the Ear.
HORATIO C. WOOD, M.D., Clinical Professor of Nervous Diseases.
LOUIS A. DUHRING, M.D., Clinical Professor of Diseases of the Skin.

Matriculates who have not received a collegiate degree are required to pass a preliminary examination in English and Physics (for details of which see Announcement), and to attend three winter courses of instruction of five months each, consisting of graded didactic lectures, clinical lectures, and practical work in laboratories and hospitals.

In the graded curriculum adopted, the elementary branches are taught in the *first* course, and students are finally examined at its conclusion upon General Chemistry, Materia Medica, and Pharmacy. In the *second* term, while a sufficient repetition of unfinished branches is secured, certain more practical ones are added, and the examinations on Anatomy, Physiology, and Medical Chemistry at the end of the term are final. In the *third* course is added practical bedside instruction in Medicine, Surgery, and Gynæcology, with clinical facilities in the specialties: and, at its end, students are examined on General Pathology and Morbid Anatomy, Therapeutics, Theory and Practice of Medicine, Surgery, and Obstetrics.

Students, who have attended one course in a regular* medical school, will be admitted as students of the second course in the University, after having satisfactorily passed an examination in General Chemistry and Materia Medica and Pharmacy. Students who have attended two courses in a regular medical school, will be admitted as students of the third course after examination in General and Medical Chemistry, Materia Medica and Pharmacy, Anatomy, and Physiology.

Graduates of other regular medical schools in good standing will be admitted as students of the third course in this institution without any examination.

Graduates of Colleges of Pharmacy and Dental Colleges in good standing are admitted to the *second* course in the University without an examination.

In the Spring Session, beginning the first Monday in April, and ending about the middle of June, a valuable course on practical and scientific subjects by a large corps of professors and lecturers is given; and the laboratories of Chemistry, Pharmacy, Histology, Physiology, and Pathology are open, affording a valuable post-graduate course.

A course of practical instruction for graduates has been established, for particulars of which see the Announcement of the Medical Department.

The Lectures of the Winter Session of 1880-81 *will begin on Monday, October* 4, *and end on the last day of February.*

The Preliminary Course will begin on the second Monday in September.

Fees in advance.—1st course of lectures, including matriculation and dissection, $155. Dissecting material one dollar a part. 2d course, including dissection, $150. 3d course, including operating and bandaging $110. Graduation fee $30.

For Announcement giving full particulars address

JAMES TYSON, M.D., Secretary,
P. O. Box 2838, Philadelphia.

* Homœopathic and Eclectic schools are not recognized as being in this category.

BELLEVUE HOSPITAL MEDICAL COLLEGE,

CITY OF NEW YORK.

SESSIONS OF 1880—1881.

THE COLLEGIATE YEAR in this Institution embraces the Regular Winter Session and a Spring Session. THE REGULAR SESSION will begin on Wednesday, September 15, 1880, and end about the middle of March, 1881. During this Session, in addition to four didactic lectures on every week-day except Saturday, two or three hours are daily allotted to clinical instruction. Attendance upon three regular courses of lectures is required for graduation. THE SPRING SESSION consists chiefly of recitations from Text-Books. This Session begins about the middle of March and continues until the middle of June. During this Session, daily recitations in all the departments are held by a corps of Examiners appointed by the Faculty. Short courses of lectures are given on special subjects, and regular clinics are held in the Hospital and in the College building.

FACULTY.

ISAAC E. TAYLOR, M.D.,
Emeritus Prof. of Obstetrics and Dis. of Women and Children, and Pres. of the Faculty.

JAMES R. WOOD, M.D., LL.D.,
Emeritus Professor of Surgery.

FORDYCE BARKER, M.D., LL.D.,
Professor of Clinical Midwifery and Diseases of Women.

BENJAMIN W. McCREADY, M.D.,
Emeritus Prof. of Materia Medica and Therapeutics, and Prof. of Clinical Medicine.

AUSTIN FLINT, M.D.,
Professor of the Principles and Practice of Medicine, and Clinical Medicine.

W. H. VAN BUREN, M.D., LL.D.,
Prof. of Principles and Practice of Surgery, Diseases of Genito-Urinary System, and Clinical Surgery.

LEWIS A. SAYRE, M.D.,
Professor of Orthopedic Surgery and Clinical Surgery.

ALEXANDER B. MOTT, M.D.,
Professor of Clinical and Operative Surgery.

WILLIAM T. LUSK, M.D.,
Prof. of Obstetrics and Diseases of Women and Children, and Clinical Midwifery.

A. A. SMITH, M.D.,
Prof. of Materia Medica and Therapeutics and Clinical Medicine.

AUSTIN FLINT, JR., M.D.,
Professor of Physiology and Physiological Anatomy, and Secretary of the Faculty.

JOSEPH D. BRYANT, M.D.,
Prof. of General, Descriptive, and Surgical Anatomy.

R. OGDEN DOREMUS, M.D., LL.D.,
Professor of Chemistry and Toxicology.

EDWARD G. JANEWAY, M.D.,
Prof. of Pathological Anatomy and Histology, Diseases of the Nervous System, and Clinical Medicine.

PROFESSORS OF SPECIAL DEPARTMENTS, ETC.

HENRY D. NOYES, M.D.,
Professor of Ophthalmology and Otology.

J. LEWIS SMITH, M.D.,
Clinical Professor of Diseases of Children.

EDWARD L. KEYES, M.D.,
Professor of Dermatology and Adjunct to the Chair of Principles of Surgery.

JOHN P. GRAY, M.D., LL.D.,
Prof. of Psychological Medicine and Medical Jurisprudence.

ERSKINE MASON, M.D.,
Clinical Professor of Surgery.

JOSEPH W. HOWE, M.D.,
Clinical Professor of Surgery.

LEROY MILTON YALE, M.D.,
Lecturer Adjunct on Orthopedic Surgery.

BEVERLY ROBINSON, M.D.,
Lecturer on Clinical Medicine.

FRANK H. BOSWORTH, M.D.,
Lecturer on Diseases of the Throat.

CHARLES A. DOREMUS, M.D., PH.D.,
Lecturer on Practical Chemistry and Toxicology, and Adjunct to the Chair of Chemistry and Toxicology.

FREDERICK S. DENNIS, M.D., M.R.C.S.,

WILLIAM H. WELCH, M.D.,
Demonstrators of Anatomy.

FACULTY FOR THE SPRING SESSION.

FREDERICK A. CASTLE, M.D.,
Lecturer on Pharmacology.

WILLIAM H. WELCH, M.D.,
Lecturer on Pathological Histology.

CHARLES A. DOREMUS, M.D., PH.D.,
Lecturer on Animal Chemistry.

T. HERRING BURCHARD, M.D.,
Lecturer on Surgical Emergencies.

Lecturer on Normal Histology.

CHARLES S. BULL, M.D.,
Lecturer on Ophthalmology and Otology.

THE FEES for the REGULAR SESSION are as follows:—Fees for the first and second year, each, $140; Fees for all third-year Students and for all Graduates of other Colleges, $100; Matriculation Fee, $5; Dissection Fee (including material for dissection), $10; Graduation Fee, $30, or $10 for each of the three yearly examinations. The following are the FEES for the SPRING SESSION:—Matriculation (Ticket valid for the following Winter), $5; Recitations, Clinics, and Lectures, $35; Dissection (Ticket valid for the following Winter), $10.

MATRICULATION EXAMINATION.—The matriculation examination will consist of English composition (one foolscap page of original composition upon any subject, in the handwriting of the candidate); Grammar, an examination upon the above-mentioned composition; Arithmetic, including vulgar and decimal fractions; Algebra, including equations; Geometry, first two books of Euclid. This examination will be waived for those who have received the degree of A.B., those who have passed the freshmen examination for entrance into any incorporated literary college, those who present certificates of proficiency in the subjects of the matriculation examination from the principal or teachers of any reputable high school, and those who have passed a matriculation examination at any recognized medical college or at any scientific school or academy in which an examination is required for admission.

☞ For the annual Circular and Catalogue, giving full Regulations for Graduation and other information, address

Prof. AUSTIN FLINT, Jr., Secretary Bellevue Hospital Medical College.

HARVARD UNIVERSITY.

MEDICAL DEPARTMENT—Boston, Mass.

NINETY-EIGHTH ANNUAL ANNOUNCEMENT. (1880-81.)

All candidates for admission after September, 1880, who hold no degree in arts or science, must pass a written examination on entrance to this School, in English, Latin, Physics, and any of the following subjects: French, German, Elements of Algebra or of Plane Geometry, Botany. The admission examination for 1880–81 will be held June 28, at Boston, Chicago, and Cincinnati; on September 27th, at Boston only. The requirements are stated in the Catalogue.

Instruction is given by lectures, recitations, clinical teaching, and practical exercises, distributed throughout the academic year. In the subjects of anatomy, histology, chemistry, and pathological anatomy, laboratory work is largely substituted for, or added to, the usual methods of instruction. The year begins September 30, 1880, and ends on the last Wednesday in June, 1881. It is divided into two equal terms, either of which is more than equivalent to the former "Winter Session," as regards the amount and character of the instruction.

The course of study recommended by the Faculty covers four years, but until further notice the degree of Doctor of Medicine will continue to be given upon the completion of three years of study, to be as ample and full as heretofore. The degree of Doctor of Medicine *cum laude* will be given to candidates who have pursued a complete four years' course, and obtained an average of 75 per cent. upon all the examinations of this course. In addition to the ordinary degree of Doctor of Medicine as heretofore obtained, a certificate of attendance on the studies of the fourth year will be given to such students desiring it as shall have attended the course, and have passed a satisfactory examination in the studies of the same.

ORDER OF STUDIES AND EXAMINATIONS.

Four-Years' Course.

For the First Year.—Anatomy, Physiology, and General Chemistry.

For the Second Year.—Practical and Topographical Anatomy, Medical Chemistry, Materia Medica, Pathological Anatomy, Clinical Medicine, Surgery, and Clinical Surgery.

For the Third Year.—Therapeutics, Obstetrics, Theory and Practice of Medicine, Clinical Medicine, Surgery, and Clinical Surgery.

For the Fourth Year.—Ophthalmology, Otology, Dermatology, Syphilis, Laryngology, Mental Diseases, Diseases of the Nervous System, Diseases of Women, Diseases of Children, Obstetrics, Clinical and Operative Obstetrics, Clinical Medicine, Clinical and Operative Surgery, Hygiene, Forensic Medicine.

Students are divided into four classes, according to their time of study and proficiency, and during their last year will receive largely increased opportunities of instruction in the special branches mentioned. Students who apply for admission to the advanced classes must pass an examination in the branches already pursued by the class to which they seek admission. The examinations are held in the following order:—

At the end of the first year—Anatomy, Physiology, and General Chemistry.

End of second year—Topographical Anatomy, Medical Chemistry, Materia Medica, and Pathological Anatomy.

End of third year—Therapeutics, Obstetrics, Theory and Practice of Medicine, Surgery.

End of fourth year—Ophthalmology, Otology, Dermatology, Syphilis, Laryngology, Mental Diseases, Diseases of the Nervous System, Diseases of Women, Diseases of Children, Obstetrics, Clinical and Operative Obstetrics, Clinical Medicine, Clinical and Operative Surgery, Hygiene, Forensic Medicine.

Three-Years' Course.

For the First Year.—Anatomy, Physiology, and General Chemistry.

For the Second Year.—Practical and Topographical Anatomy, Medical Chemistry, Materia Medica, Pathological Anatomy, Clinical Medicine, and Clinical Surgery.

For the Third Year.—Therapeutics, Obstetrics, Theory and Practice of Medicine, Clinical Medicine, Surgery, Clinical Surgery, Ophthalmology, Dermatology, Syphilis, Otology, Laryngology, Mental Diseases, Diseases of the Nervous System, Diseases of Women, Diseases of Children, Hygiene, Forensic Medicine.

Students following this course are classified as heretofore, and the instruction in the special branches is of the same character as that which has been given for several years. The examinations of the first two years are common to both groups of students. The final examinations at the close of the third year are in the following subjects; Therapeutics, Obstetrics, Surgery and Clinical Surgery, Theory and Practice, Clinical Medicine.

Examinations in all subjects are also held before the opening of the School, beginning September 27th.

Requirements for a Degree.—Every candidate must be twenty-one years of age; must have studied medicine three or four full years, have spent at least one continuous year at this school, have passed a written examination upon all the prescribed studies of the course taken, and have presented a thesis.

Course for Graduates.—For the purpose of affording to those already Graduates of Medicine additional facilities for pursuing clinical, laboratory, and other studies, in such subjects as may specially interest them, the Faculty has established a course which comprises, in addition to the list of special departments above stated, the following branches: Histology; Physiology; Medical Chemistry; Pathological Anatomy. On payment of the full fee the privilege of attending any of the other exercises of the Medical School, the use of the laboratories and library, and all other rights accorded by the University will be granted. Single branches may also be pursued. Graduates of other Medical Schools who may desire to obtain the degree of M.D. at this University, will be admitted to examination for this degree after a year's study in the Graduates' Course. Examination on entrance not required.

Fees.—For Matriculation, $5; for the Year, $200; for one Term alone, $120; for Graduation, $30. For Graduates' Course, the fee for one year is $200; for one Term, $120; and for single courses such fees as are specified in the Catalogue. Payment in advance.

Members of any one department of Harvard University have a right to attend lectures and recitations in any other department without paying additional fees.

For further information, or Catalogue, address

Dr. R. H. FITZ, *Sec'y*, 16 Arlington St., Boston, Mass.

UNIVERSITY OF THE CITY OF NEW YORK.
MEDICAL DEPARTMENT.

410 East Twenty-Sixth St., opposite Bellevue Hospital, New York.

THIRTY-NINTH SESSION—1880–81.

FACULTY OF MEDICINE.

REV. HOWARD CROSBY, M.D., LL.D., Chancellor of the University.
ALFRED C. POST, M.D., LL.D., Emeritus Professor of Clinical Surgery; President of the Faculty.
CHARLES INSLEE PARDEE, M.D., Professor of Diseases of the Ear; Dean of the Faculty.
JOHN C. DRAPER, M.D., LL.D., Professor of Chemistry.
ALFRED L. LOOMIS, M.D., Professor of Pathology and Practice of Medicine.
WILLIAM DARLING, A.M., M.D., LL.D., F.R.C.S., Professor of Anatomy.
WILLIAM H. THOMSON, M.D., Professor of Materia Medica and Therapeutics.
J. W. S. ARNOLD, M.D., Professor of Physiology and Histology.
J. WILLISTON WRIGHT, M.D., Professor of Surgery.
WM. M. POLK, M.D., Professor of Obstetrics and Diseases of Women and Children.
FANEUIL D. WEISSE, M.D., Professor of Practical and Surgical Anatomy.
LEWIS A. STIMSON, M.D., Professor of Pathological Anatomy.
A. L. RANNEY, M.D., Adjunct Professor of Anatomy.
JOSEPH E. WINTERS, M.D., Demonstrator of Anatomy.

POST-GRADUATE FACULTY.

D. B. ST. JOHN ROOSA, M.D., Professor of Ophthalmology.
WM. A. HAMMOND, M.D., Professor of Diseases of the Mind and Nervous System.
STEPHEN SMITH, M.D., Professor of Orthopædic Surgery.
J. W. S. GOULEY, M.D., Professor of Diseases of the Genito-Urinary System.
MONTROSE A. PALLEN, M.D., LL.D., Professor of Gynæcology.
HENRY G. PIFFARD, M.D., Professor of Dermatology.
A. E. MACDONALD, M.D., Professor of Medical Jurisprudence.
JAMES L. LITTLE, M.D., Clinical Professor of Surgery.
F. R. STURGIS, M.D., Clinical Professor of Venereal Diseases.

THE COLLEGIATE YEAR is divided into three Sessions: a Preliminary Session, a Regular Winter Session, and a Spring Session.

THE PRELIMINARY SESSION will commence September 15, 1880, and will continue until the opening of the Regular Winter Session. It will be conducted on the plan of that Session.

THE REGULAR WINTER SESSION will commence on September 27, 1880, and end about the 1st of March, 1881.

The location of the new College edifice being immediately opposite the gate of Bellevue Hospital, and a few steps from the ferry to Charity Hospital, Blackwell's Island, the Students of the University Medical College are enabled to enjoy the advantages afforded by these Hospitals, with the least possible loss of time. The Professors of the practical Chairs are connected with the Hospitals, and the University Students are admitted to *all the Clinics* given therein *free of charge*.

In addition to the daily Hospital Clinics, there are eight Clinics each week in the College Building. Five Didactic Lectures will be given daily in the College building, and Evening Recitations will be conducted by the Professors of Chemistry, Practice, Anatomy, Materia Medica, etc., Physiology, Surgery, and Obstetrics, upon the subjects of their Lectures.

THE SPRING SESSION embraces a period of twelve weeks, beginning in the first week of March and ending the last week of May. The daily Clinics, Recitations, and Special Practical Courses will be the same as in the Winter Session, and there will be Lectures on Special Subjects by the Members of the Post-Graduate Faculty.

THE DISSECTING ROOM is open throughout the entire Collegiate year; material is abundant, and it is furnished free of charge.

STUDENTS WHO HAVE STUDIED TWO YEARS, and who have attended two full courses of lectures, may be admitted to examination in Chemistry, Anatomy, and Physiology, and, if successful, will be examined at the expiration of their full course of study on Practice, Materia Medica and Therapeutics, Surgery, and Obstetrics; but those who prefer it may have all their examinations at the close of their full term.

FEES.

For Course of Lectures	$140 00
Matriculation	5 00
Demonstrator's fee, including material for dissection	10 00
Graduation fee	30 00
Post-Graduate certificate	30 00

For further particulars and circulars address the Dean,

Prof. CHAS. INSLEE PARDEE, M.D.,
University Medical College, 410 East 26th St., New York.

MEDICAL DEPARTMENT OF THE UNIVERSITY OF LOUISIANA—NEW ORLEANS.

FACULTY.

T. G. Richardson, M.D., Professor of General and Clinical Surgery.

Samuel M. Bemiss, M.D., Professor of the Theory and Practice of Medicine and Clinical Medicine.

Stanford E. Chaillé, M.D., Professor of Physiology and Pathological Anatomy.

Joseph Jones, M.D., Professor of Chemistry and Clinical Medicine.

Samuel Logan, M.D., Professor of Anatomy and Clinical Surgery.

Ernest S. Lewis, M.D., Professor of General and Clinical Obstetrics and Diseases of Women and Children.

John B. Elliott, M.D., Professor of Materia Medica and Therapeutics and Clinical Medicine.

Albert B. Miles, Demonstrator of Anatomy.

The next annual course of instruction in this Department (now in the forty-seventh year of its existence) will commence on Monday, the 18th day of October, 1880, and terminate on Saturday, the 12th day of March, 1881. The first three weeks of the term will be devoted exclusively to Clinical Medicine and Surgery at the Charity Hospital; Practical Chemistry in the Laboratory; and dissections in the spacious and airy Anatomical Rooms of the University.

The means of teaching now at the command of the Faculty are unsurpassed in the United States. Special attention is called to the opportunities presented for

CLINICAL INSTRUCTION.

The Act establishing the University of Louisiana gives the Professors of the Medical Department the use of the great Charity Hospital as a school of practical instruction.

The Charity Hospital contains nearly 700 beds, and received, during the last year, more than six thousand patients. Its advantages for professional study are unsurpassed by any similar institution in this country. The Medical, Surgical, and Obstetrical Wards are visited by the respective professors in charge daily, from eight to ten o'clock A. M., at which time all the students are expected to attend and familiarize themselves, *at the bedside of the patients*, with the diagnosis and treatment of all forms of injury and disease.

The regular lectures at the hospital, on Clinical Medicine by Professors Bemiss, Elliott, and Joseph Jones, Surgery by Professors Richardson and Logan, Diseases of Women and Children by Professor Lewis, and Special Pathological Anatomy by Professor Chaillé, will be delivered in the amphitheatre on Monday, Wednesday, Thursday, and Saturday, from 10 to 12 o'clock A. M.

The administrators of the hospital elect annually, by competitive examinations, *twelve resident students*, who are maintained by the institution.

TERMS.

For the Tickets of all the Professors	$140 00
For the Ticket of Practical Anatomy	10 00
Matriculation Fee	5 00
Graduation Fee	30 00

Candidates for graduation are required to be twenty-one years of age; to have studied three years; to have attended two courses of lectures, and to pass a satisfactory examination.

Graduates of other respectable schools are admitted upon payment of the Matriculation and half lecture fees. They cannot, however, obtain the Diploma of the University without passing the regular examinations and paying the usual Graduation Fee.

As the practical advantages here afforded for a thorough acquaintance with all the branches of medicine and surgery are *quite equal* to those possessed by the schools of New York and Philadelphia, the same fees are charged.

For further information, address T. G. RICHARDSON, M.D., *Dean.*

BOYLSTON MEDICAL PRIZE QUESTIONS.

The Boylston Medical Committee, appointed by the President and Fellows of Harvard University, consists of the following Physicians:—

D. H. Storer, M.D.,
Morrill Wyman, M.D.,
Henry J. Bigelow, M.D.,
Richard M. Hodges, M.D.,
Calvin Ellis, M.D.,
Samuel Cabot, M.D.

At the annual meeting, held June 2, 1880, it was voted that a prize of one hundred and fifty dollars be awarded to W. Watson Cheyne, F.R.C.S., Assistant Surgeon of King's College Hospital, London, for a dissertation on "Antiseptic Treatment: What are its Essential Details? How are they best carried out in Practical Form?" It was also voted that, in view of the great excellence of this dissertation, there be added to the award the Boylston Prize Gold Medal.

The following are the questions proposed for 1881:—

I. The Effects of Drugs, during Lactation, on either nurse or nursling.

II. Injuries to the Back, without apparent mechanical lesion, in their surgical and medico-legal aspects.

The author of a dissertation considered worthy of a prize, on either of the subjects proposed for 1881, will be entitled to a premium of Three Hundred Dollars.

Dissertations on the above subjects must be transmitted, post-paid, to D. H. Storer, M.D., 182 Boylston Street, Boston, Massachusetts, *on or before the first Wednesday in April*, 1881.

The following are the questions proposed for 1882:—

I. Sewer Gas (the gas found in Sewers): What are its Physiological Effects on Animals and Plants? An Experimental Inquiry.

The author of a dissertation on the above subject, considered worthy of a prize, will be entitled to a premium of Three Hundred Dollars.

II. The Therapeutic Value of Food, administered against, or beyond, the Patient's Appetite and Inclination.

The author of a dissertation on the above subject, considered worthy of a prize, will be entitled to a premium of Two Hundred Dollars.

Dissertations on these subjects must be transmitted as above, on or before the first Wednesday in April, 1882.

Each dissertation must be accompanied by a sealed packet on which shall be written some device or sentence, and within which shall be inclosed the author's name and residence. The same device or sentence is to be written on the dissertation to which the packet is attached.

The writer of each dissertation is expected to transmit his communication to the President of the Committee, D. H. Storer, M.D., 182 Boylston St., Boston, Mass., in a distinct and plain handwriting, *and with the pages bound in book form*, within the time specified.

Any clew by which the authorship of a dissertation is made known to the Committee will debar such dissertation from competition.

Preference will be given to dissertations which exhibit original work.

All unsuccessful dissertations are deposited with the Secretary, from whom they may be obtained, with the sealed packet unopened, if called for within one year after they have been received.

By an order adopted in 1826, the Secretary was directed to publish annually the following votes:—

1st. That the Board do not consider themselves as approving the doctrines contained in any of the dissertations to which premiums may be adjudged.

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